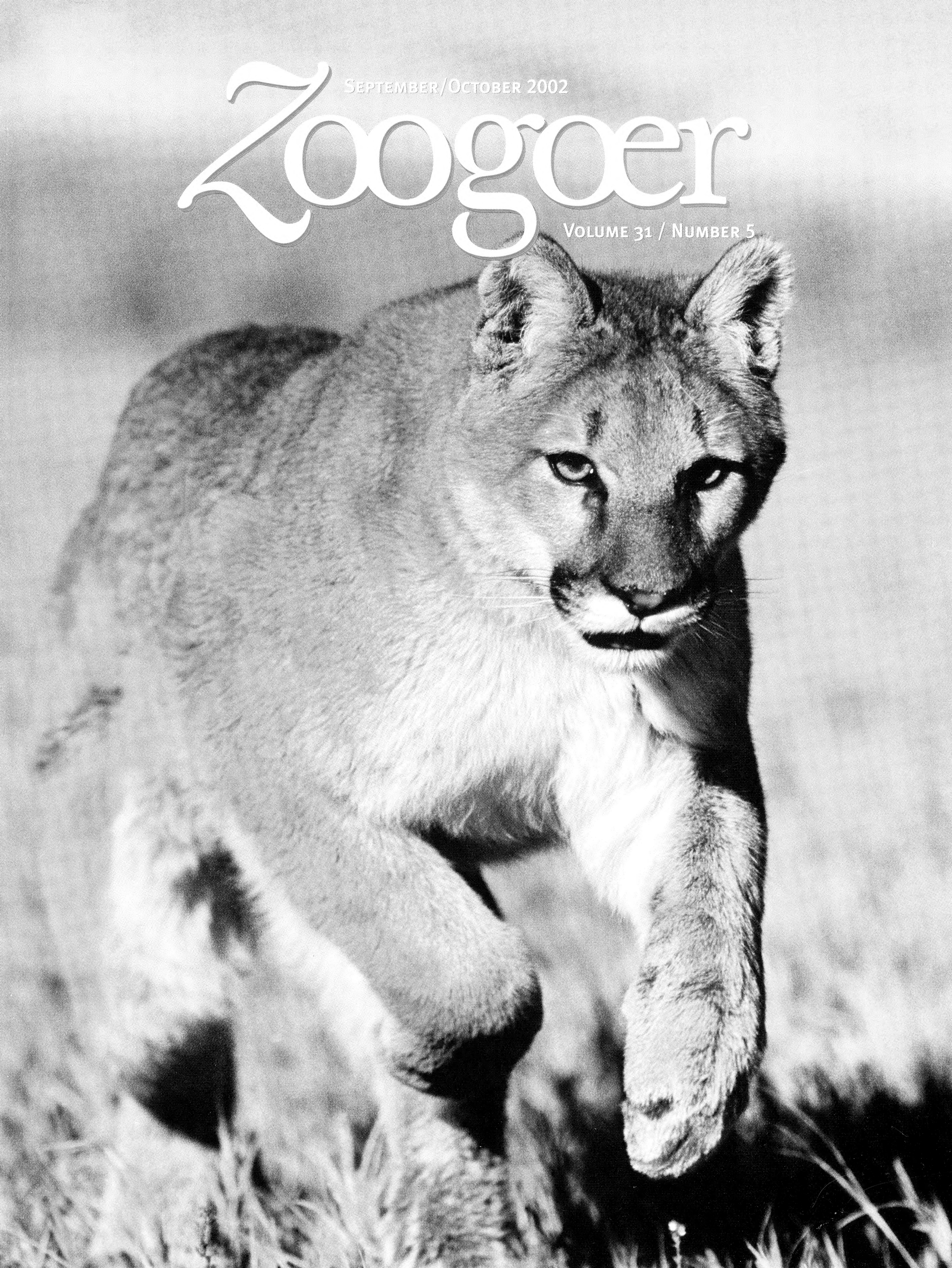
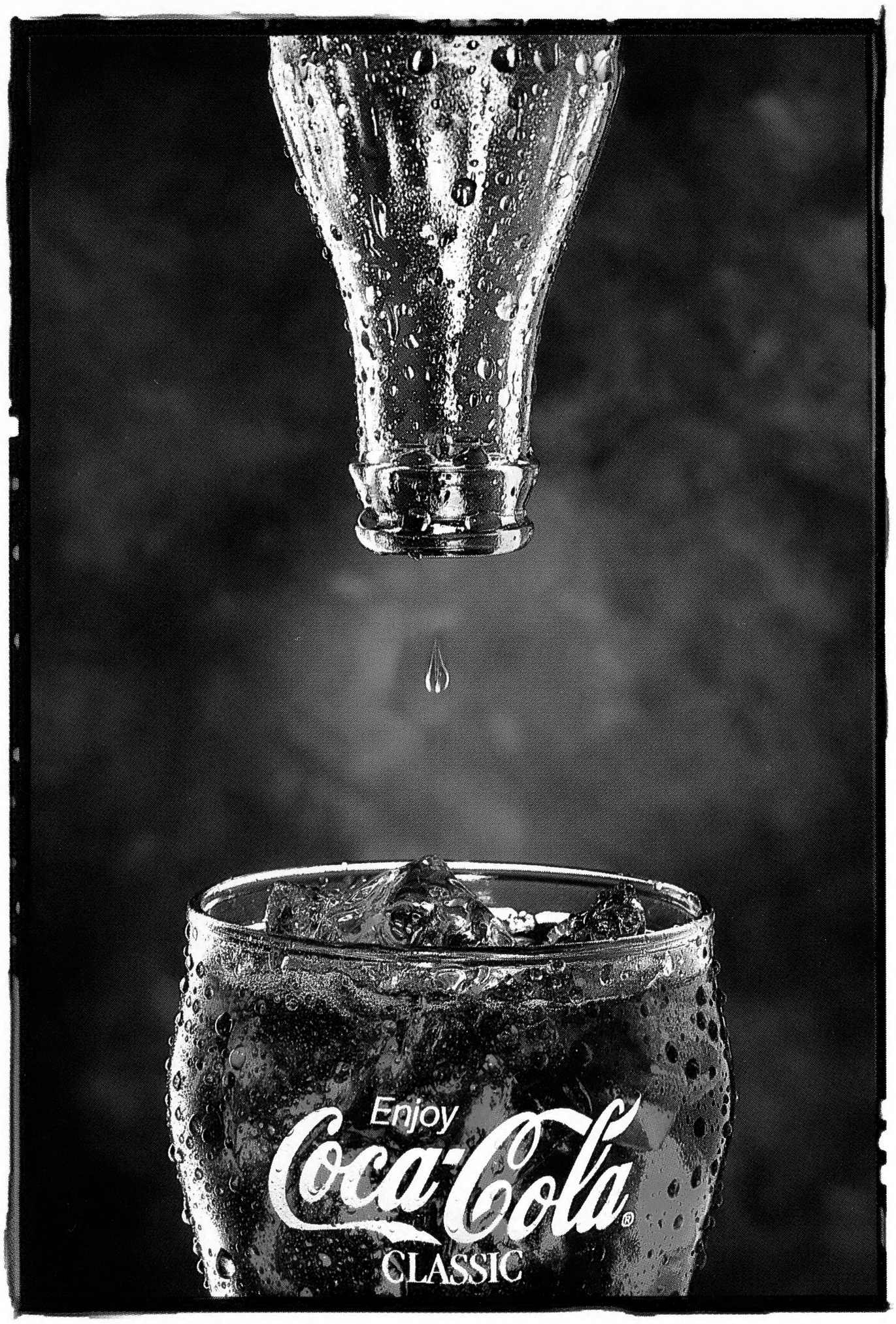
September/October 2002

Zoogoer

Volume 31 / Number 5





YOU'RE A DROP OF REFRESHMENT IN A THIRSTY WORLD.

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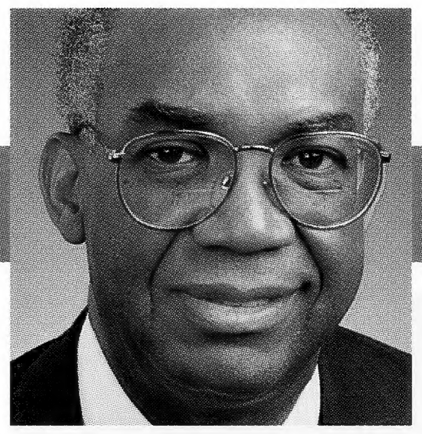

FONZ Forum

This morning, I stopped for a moment at the Cheetah Conservation Station overlook. The cheetah in this habitat appeared unusually alert and active, and I was curious about what had attracted its attention. I didn't see anything out of the ordinary, however, and my gaze drifted to the goldfish swimming brightly in the pond below me. Only after watching for a few minutes did I notice a fist-size bullfrog perched on a floating-heart leaf under the plant's banana-yellow flowers. Scanning the pond more closely now, I soon counted ten bullfrogs, all resting in near-identical poses on the leaves.

Bullfrogs have lived from time to time in my backyard pond, so I know that bullfrog watching can seem pretty tedious. The frog sits still most of the time, waiting for a meal to buzz by. And when an ill-fated fly or mosquito does come near, the act of predation is over in a flash of the frog's long sticky tongue, a leap, and a splash. And usually all I really see is the splash. But tedium is rooted in not knowing what we're looking at. Attracted and intrigued by action—like the cheetah's stalking that drew me to the overlook—we need to be encouraged to find the excitement inherent in those mostly motionless frogs. The excitement is there, as it is in all living creatures, but it often has to be revealed to us. Our continuing challenge at FONZ and the Smithsonian's National Zoo is to find ways to reveal this excitement to our visitors.

Almost 30 years ago, William Conway, the highly respected long-time director of the Wildlife Conservation Society (formerly the New York Zoological Society) and its Bronx Zoo, addressed this challenge in a paper entitled, coincidentally, "How to exhibit a bullfrog: a bedtime story for zoo men." Conway's story was about how an exhibit of even a lowly amphibian, properly done to include all aspects of its natural and cultural history, can inspire wonder at species' intricate adaptations, spark an interest in exploring the natural world more fully, and evoke feelings of connection with nature and concern about its future. Of course, Conway's bullfrog could have been a tiger or a toucan or a buttercup—all have awesome stories to tell.

We tell these stories in various ways at the Zoo: in our exhibit signs, in our classes and workshops, in *ZooGoer* and other publications. But our best storytellers are our animals themselves. Visitors see an Asian elephant pick up a slender piece of straw with the tip of its trunk or a sloth bear suck up ants with its mobile snout. Watch an orang utan brachiate across the O-line or a crane dance elegantly to entice a mate. Hear white-cheeked gibbons or seriemas sing in duet.

Unfortunately, at present, the power of these stories is reduced by the aging and outmoded state of many of our exhibit facilities. As Lucy Spelman suggests in her letter on page 5, we won't be the great zoo we once were until our exhibit spaces are dramatically improved to truly showcase the natural behavior of our species and to enhance their stories with the results of our scientific research and the breadth of our conservation initiatives. Asia Trail, on which we will break ground in the winter, will achieve this, and Africa Trail will follow.

But other, less visible programs are also emerging. One is our Backyard Biology program, which aims to show people the wonders of wildlife that live in the Zoo's—and our own—backyards. Wildlife such as chipmunks, cardinals, black-crowned night herons, and, yes, bullfrogs are as much a part of our threatened natural heritage as giant pandas and Komodo dragons.

Exciting changes continue apace as we revitalize the National Zoo. Please come often to watch us grow younger.

Sincerely,

Clinton A. Fields
Executive Director

Friends of the National Zoo is a non-profit organization dedicated to supporting the conservation, education, and research efforts of the Smithsonian's National Zoo. Formed in 1958, FONZ was one of the first conservation organizations in the nation's capital. Friends of the National Zoo is dedicated to supporting the Smithsonian's National Zoo in a joint mission to study, celebrate, and help protect the diversity of animals and their habitats.

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Smithsonian ***National Zoological Park*** is located at 3001 Connecticut Ave., N.W., Washington, DC 20008-2537. Weather permitting, the Zoo is open every day except December 25. Hours: From May 1 to September 15, grounds are open from 6 a.m. to 8 p.m.; buildings, 10 a.m. to 6 p.m. From September 16 to April 30, grounds are open from 6 a.m. to 6 p.m.; buildings, 10 a.m. to 4:30 p.m.

Membership in FONZ offers many benefits: publications, discounts on shopping, programs, and events, free parking, and invitations to special programs and activities to make zoogoing more enjoyable and educational. To join, write FONZ Membership, National Zoological Park, Washington, DC 20008, call 202.673.4961 or go to www.fonz.org.

Membership categories and annual tax-deductible dues are:

Family (includes children 3-16 years)	$49
Double	$44
Individual	$39
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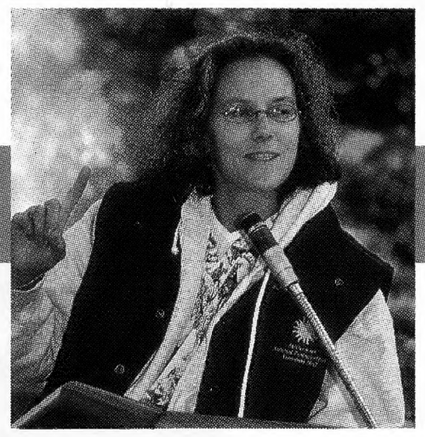


Letter from the Zoo Director

Can the Smithsonian's National Zoo Be Restored to "Great Zoo" Status?

Great zoos captivate their visitors through exhibits that introduce them to the beauty and majesty of animals in natural settings. They teach us about the needs of these animals, the lives they lead, and the dangers that threaten them. Great zoos motivate people to care about animals and to take action to help them, rather than harm them. If not for zoos, many people would never experience wild animals firsthand or develop the personal bonds that touch hearts and inspire minds.

Great zoos provide attractive, interesting, naturalistic enclosures for animals that ensure their well-being and encourage breeding as insurance against declining numbers in the wild. Interactive graphics help visitors understand facts about the animal's unique biology and its status in the wild. Zoo programs include education, research, and conservation activities that take place on site as well as in the field. Zoos collaborate with each other, and with non-governmental agencies involved in wildlife management and conservation all over the world. In short, zoos are a major force in shaping the public's opinion regarding the need to protect wildlife.

There are a handful of great zoos in the world. Historically, the National Zoo was one of them. However, with the progressive deterioration of our physical facilities, we have lost our "great zoo" status.

Founded in 1889, the National Zoo is one of the oldest zoological parks in the United States. Our attendance ranks among the top ten for all zoos in the United States with two to three million visitors each year. Our animal collection includes 3,100 specimens, representing 435 species from around the world, many of them threatened or endangered. We have a reputation for teaching and training others, particularly in the sciences, and as a leader in zoo-based research and professional training. However, years of inadequate spending on basic infrastructure have put the Zoo on a downward spiral. Our facilities are severely deteriorated and staff numbers have been steadily shrinking for the last decade. A remarkably small amount of money is spent on the National Zoo compared to other leading zoos.

We need to modernize our facilities for both people and animals so that they support our mission to celebrate, study, and protect animals and the diversity of their habitats. Our ten-year Zoo Renewal Plan, outlined in the January/February issue of *ZooGoer* (available at http://www.fonz.org/zoogoer/zg2002/31(1)VisionForFuture.htm), describes the revitalization of the National Zoo facilities. Spacious and stimulating new habitats are long overdue—and necessary to fulfill our goals of linking science to Zoo exhibits, and renewing our role as a leading center for zoo-animal care, reproductive science, and conservation research. This plan is not an expansion of our current facility, but a phased approach to revitalize its oldest areas and to take care of what we have. The Animal Program concept that I wrote about in the July/August *ZooGoer* (http://natzoo.si.edu/Spelman/letter1ja.htm) will be the guiding force—the vision—behind the physical renewal of the Zoo to ensure that we once again provide a "great zoo" experience for our visitors.

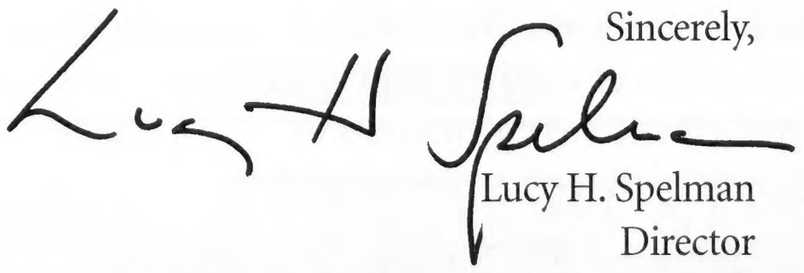
Like the endangered species in its collections, the future of the National Zoo depends on our gaining widespread support.

I believe we have unique strengths that will help us regain our place in the ranks of great zoos, but only if we work together to achieve sufficient funding for our mission, goals, and vision.

The National Zoo has the distinction of being the only zoo in this country that represents a partnership between the federal government and the private sector. The Zoo also has a long history of support from private-sector funds raised via concessions, internal and external grants awarded to scientists, and gifts from donors, foundations, and corporations. In fact, over the last several years, private fundraising has increased dramatically faster than federal funding. FONZ provides a substantial portion of the total nonfederal funds spent on the Zoo. The Conservation and Research Center Foundation, established in 2000, and the Zoo's Advisory Board supply smaller portions of private-sector funds. Still, the federal government provides about 70 percent of our funding, and we are hoping that federal support will begin to grow just as private support has grown in recent years.

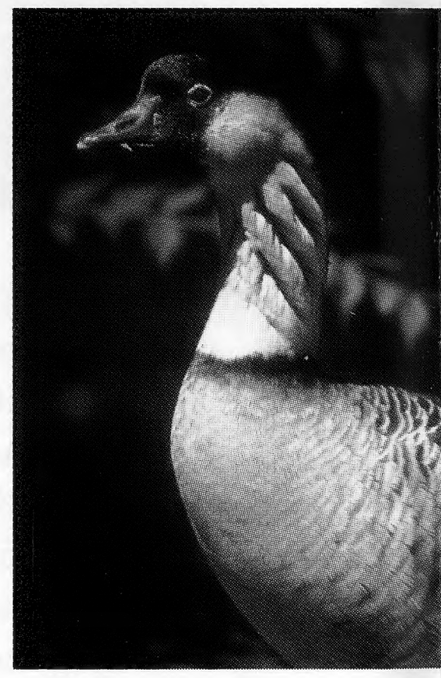
I am confident that with our plans—and your help—the National Zoo will once again be a great zoo.

Sincerely,



Lucy H. Spelman
Director
Smithsonian's National Zoological Park

Notes & News



NENE GOOSE (PRONOUNCED NAY-NAY).

JESSIE COHEN/NZP

>>ANIMAL NEWS

Approaching one year of age, Sumatran tiger Berani is doing very well, weighing in at 130 pounds as of early August. Great cats keeper Marie Magnuson could not give his length—he and his mother, Soyono, both object to that much familiarity. The feisty youth is now bearing adult teeth, although he's missing his canines, giving him an "all-I-want-for-Christmas-is-my-two-front-teeth look," according to Magnuson. One tooth came out naturally, the other was pulled after it broke. In the wild, a broken tooth can mean an infection and possibly death.

Magnuson estimates that Berani consumes about four pounds of Dallas Crown (a carnivore diet of horse meat with vitamins and minerals added) six days a week. On Sundays, he gets horse tails just like the adults—something he enjoys very much. Chewing on horse tails keeps his teeth clean and his weight down (in the wild, of course, the cats would probably not eat every day). Berani has also started his training, something that is done with the cats and other Zoo animals for various medical procedures. "He doesn't quite understand what's going on yet, but he will," says Magnuson. Keepers use operant conditioning with positive reinforcement for corrective behavior. For those interested in keeping daily tabs on the Zoo tigers, a new tiger camera is now running on the Zoo website: http://nationalzoo.si.edu/Webcams/tiger/index.htm. The schedule for who's on camera and when is: Kerinci, a female tiger, 7 a.m. to 11 a.m. (EDT); Berani, 11 a.m. to noon; Berani and his mother, Soyono, noon to 2 p.m.; and Rokan, father of Berani, 2 p.m. to 6 p.m.

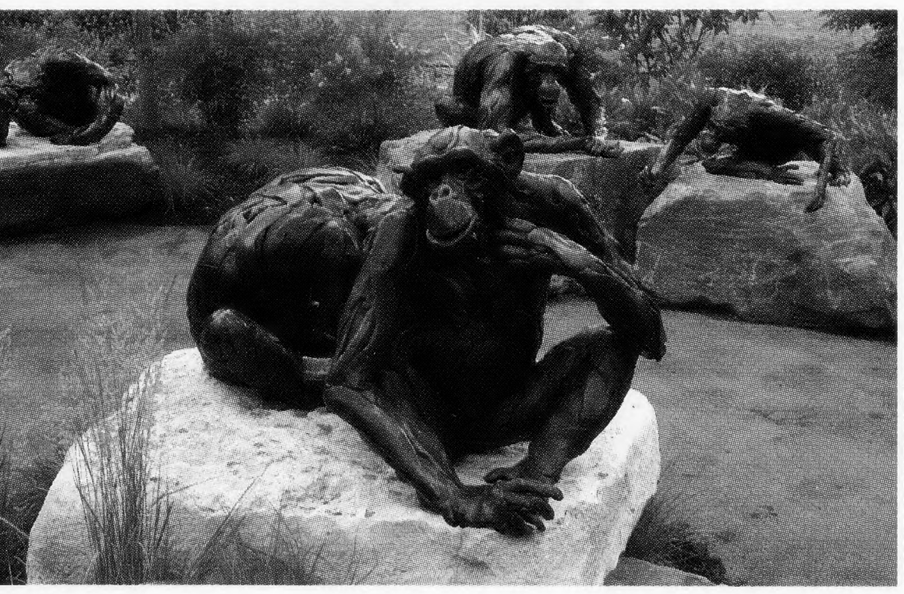
Reporting recently in the prestigious journal *Science*, Zoo scientist Jonathon Ballou and scientists from the Museum of Natural History and University of Califonia, Los Angeles, found that nene geese have had their ups and downs over the past 2,500 years. Also known as Hawaiian geese (*Branta sandvicensis*), an estimated 25,000 of these birds lived on the island of Hawaii when Captain Cook first landed in 1778. In less than 200 years, fewer than 30 were left, thanks to hunting, habitat degradation and loss, and introduced predators. Living nene exhibit very little genetic diversity but no one knew why. Diversity may have been lost when the population size plummeted after 1778, or perhaps this is a natural state for nene as it is for some island-living species. In their work, the group showed that this wasn't the first time that nene numbers had crashed, as well as when their genetic diversity was lost. With the expertise of Ellen Paxinos and Robert Fleischer in the Smithsonian's Genetics Laboratory, the group conducted DNA analysis on nene bones as old as 2,500 years. They used this to compare the genetic variation in birds that lived on Hawaii from 500 to 2,500 years ago, from 160 to 500 years ago, between 1833 and 1928, and living birds.

They found that the nene lost genetic variability between 350 and 900 years ago, well before Europeans colonized Hawaii. This was during a period of human population growth on the islands and when people were moving into even marginal lands to make a living. At least five other large Hawaiian bird species went extinct in the same period; the nene itself was extirpated on other Hawaiian islands. For more information on the nene and their persistence go to http://natzoo.si.edu or visit the Zoo's pair at Wetlands Exhibit near the Zoo's Bird House.

JESSIE COHEN/NZP

>>THE GATHERING

Bart Walter's chimpanzee sculptures, entitled "The Gathering," opened on June 18 with seven life-size chimpanzee bronzes that now adorn an area of the Zoo outside Think Tank. The sculpture garden is part of Zoo Director Lucy Spelman's ten-year revitalization program. All together, the chimpanzees illustrate nonverbal communication and the individual member roles within great-ape groups. The garden includes educational graphics and a puzzle-lesson to help visitors learn about primate social structure. For more details go to http://natzoo.si.edu/News/gathering.htm.



JESSIE COHEN/NZP

>>FONZ SENIOR DAYS

For the entire month of September—a.k.a. "Be a FONZ Month"—seniors will receive a discount in National Zoo Stores and free parking while visiting the Zoo. Those age 62 and older who join FONZ in September will receive a giant panda tote bag and a copy of the *Smithsonian Book of Giant Pandas*, plus all the other benefits that come along with "Being a FONZ." Every Tuesday from 10 a.m. to 2 p.m., there will be special activities for seniors and free refreshments on Panda Roof. For those younger than 62 years old who join in September, a free gift is also available. For more information or to become a FONZ member, please log onto www.fonz.org or call 202.673.4717.

>>YP FINALE

On September 19 from 6 to 9 p.m., Young Professionals will gather for the YP After-Hours event "Ele Phants-gerald," which will feature music, free snacks, and a cash bar. Guests will have a chance to talk with the Elephant House keepers about Shanthi, Kandula, and their pachyderm pals. Live music will be provided courtesy of a local jazz band, and snacks will be provided by an area restaurant. Tickets at the door are $8 for FONZ YP members and $10 for nonmembers. Guests can receive a discount by ordering tickets by 2 p.m. the day of the event. New YP members will receive two free tickets to any After-Hours event. To purchase tickets, please log onto www.fonz.org/getinv/ypafterhours.htm or call 202.673.4637.

>>FIESTA MUSICAL

FONZ and the Smithsonian's National Zoological Park will honor Hispanic Heritage Month with

Fiesta Musical 2002 on September 22 between 11 a.m. and 5 p.m. This free event will feature a variety of family-oriented cultural activities, including a wide range of regional dance performances, traditional handcrafts, and a Latin American food court. Guests will also be treated to animal demonstrations, bilingual games and activities, and popular Latin and folk music. Visit http://www.fonz.org for more information.

>>BOO!

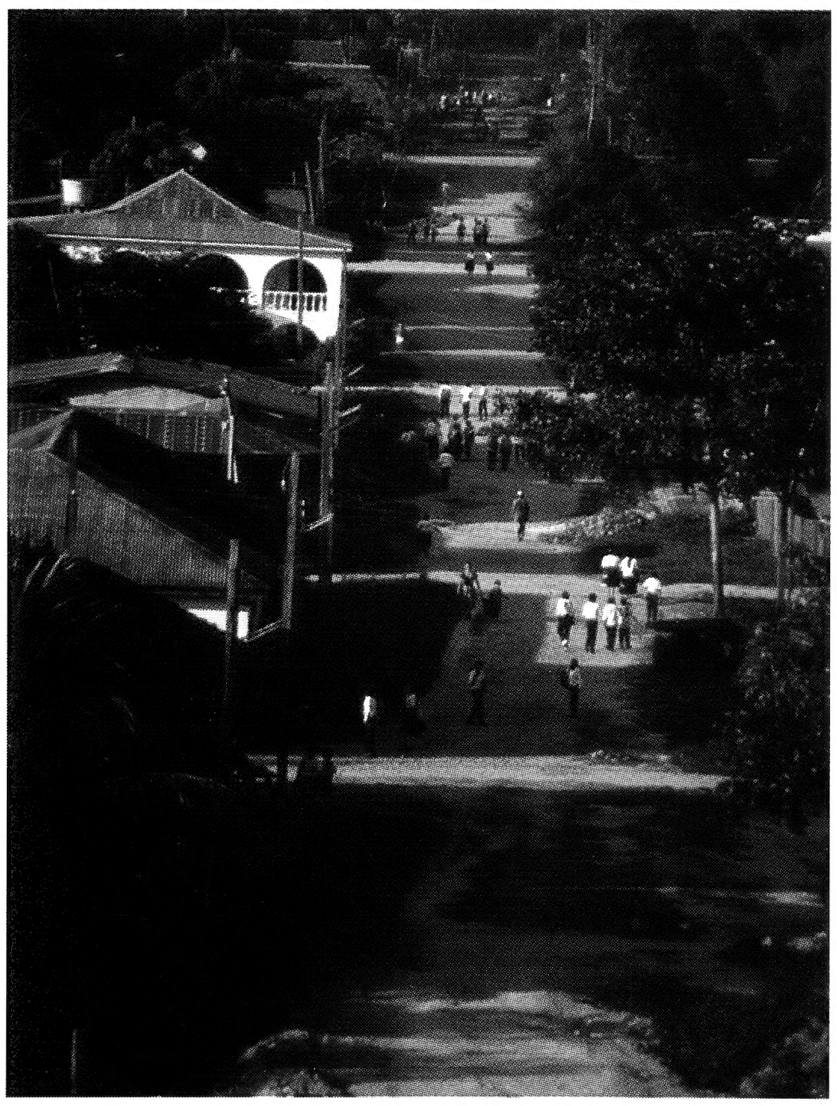
This year's Boo at the Zoo—where the true ghosts, goblins, and witches in children emerge—will take place October 25 to 27 from 5:30 to 8:30 p.m. FONZ's fourth annual Boo at the Zoo is a safe and fun way for kids and families to enjoy Halloween. As they travel through the Zoo, kids can trick-or-treat in animal houses, collect candy from costumed volunteers, and creep along haunted trails. Children under 12 are invited and must be accompanied by an adult. Tickets for the event sell out weeks in advance, so please purchase them as soon as possible. Tickets are $10 for FONZ members; $20 for nonmembers; and kids under two are admitted free. To assist guests arriving by Metro, FONZ will provide a free shuttle from the Woodley Park/Zoo/Adams Morgan Metro station. For tickets or more information, please log onto http://www.fonz.org/events/boo.htm.

>>FONZ ANNUAL MEETING

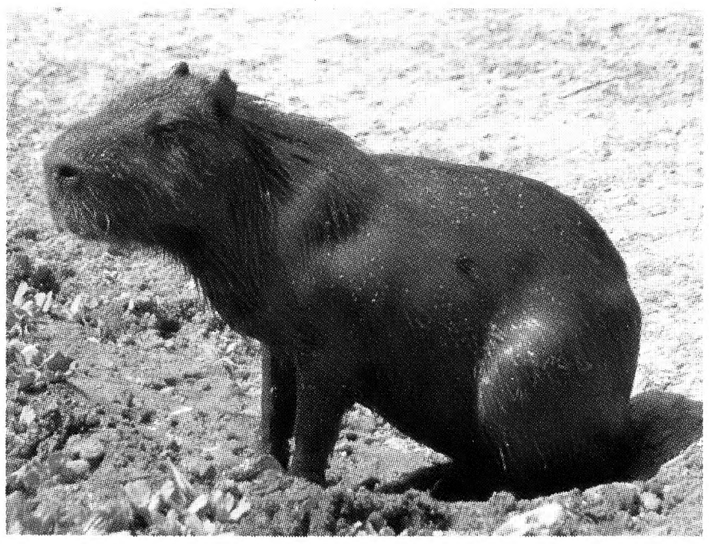
The FONZ Annual Meeting will be Friday, October 18, from 6:30 to 8:30 p.m. The evening will begin with a reception at Gorilla Grove and a preview of the updated Komodo dragon exhibit. Then, at 7:30, we will move to the Picnic Pavilion for remarks from the President of the Board on the state of FONZ and from the Zoo Director on plans for the Zoo. This is also a chance to meet the new members and directors of the FONZ Board. Please make reservations by email to annualmeeting@fonz.org or by calling 202.673.4637.

Correction: The lead photo in the article "What's Ailing Asia's Vultures," pp. 22–3 of the July/August ZooGoer *was taken by Rick Watson of The Peregrine Fund. Special thanks to Mr. Watson and The Peregrine Fund for their contribution.*

TO BOLIVIA AND BACK



ANDREW WILSON



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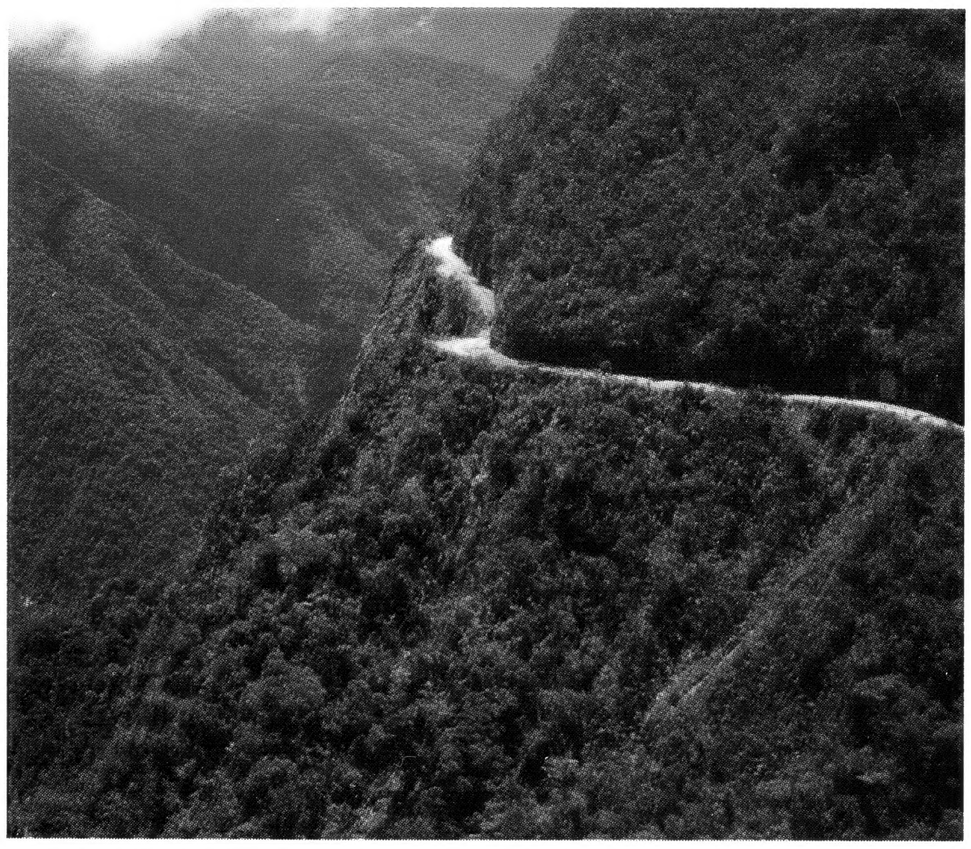

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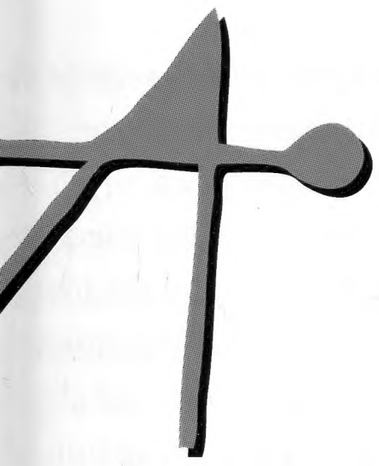
THE LAST FRONTIER



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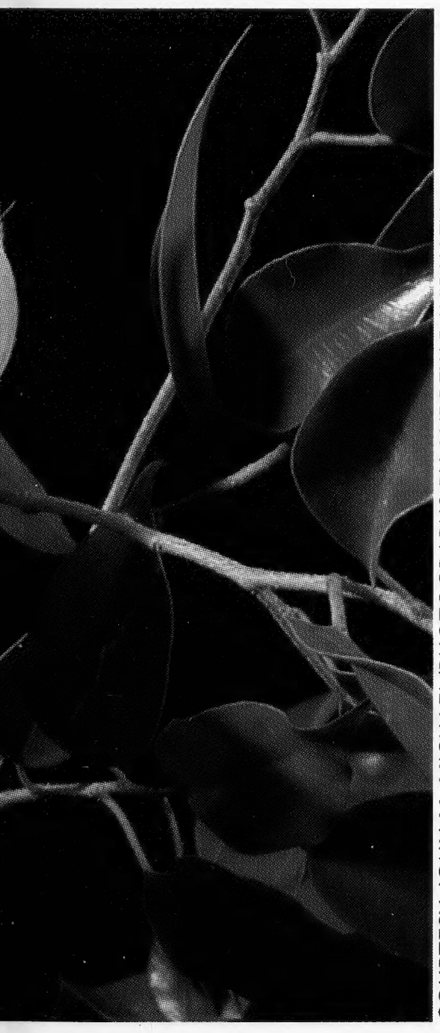

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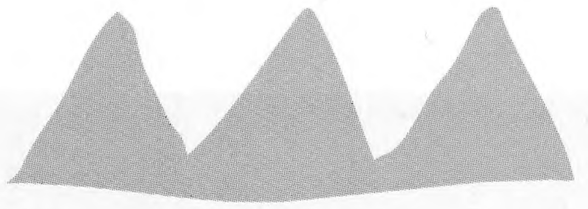

BY TERRY DUNN

"They fascinate me, these upland jungles—vast and dim and cool, stretching unbroken and untrodden for miles beyond hundreds of miles, over mountain and gorge alike, in a thick roof of perennial green. What do they contain? What mysterious creatures live in them? We don't know. We see strange tracks and hear far-away calls, some of which we know, some of which even the Indians can't explain."

For an animal lover, nothing compares to searching for an unseen animal in the jungles of the Amazon. For a scientist traveling through an unstudied rainforest, the thrill is heightened by the likelihood of finding a new species.

In the spring of 2002, I followed in some of the footsteps and paddle strokes of the gentleman who so eloquently expressed this passion for rainforest exploration. The quote comes from Gordon MacCreagh, who wrote *White Waters and Black*, a careful but sardonic record of the personality conflicts, misadventures, and, occasionally, the scientific discoveries of the Mulford Expedition to Bolivia in 1921. He was an assistant on the expedition, but his sentiment was certainly shared by another member of the expedition, William (Bill) Mann, who later became the director of the Smithsonian's National Zoological Park—a tenure he kept for more than three decades.

The Mulford Expedition (named after one of the expedition's major sponsors, the H. K. Mulford Company) began with a trudge through the snow and ended in the heat of the Bolivian Amazon. The members chose a route based on the fact that it wasn't well traveled or well mapped, a philosophy used by field biologists today. As McCreagh put it, "This uncomfortable passion for unknown routes is explained by the simple axiom that where nobody has been before, somebody may find something that nobody else has; and by the corollary that scientists risk their lives and

CLOCKWISE FROM TOP LEFT: RURRENABAQUE, BOLIVIA. CAPYBARA (*HYDROCHOERUS HYDROCHAERIS*). THE GREATER RHEA (*RHEA AMERICANA*) A RELATIVE OF THE OSTRICH. CAIQUES (*PIONITES LEUCOGASTER XANTHOMERIA*). ROAD FROM LA PAZ THROUGH THE BOLIVIAN YUNGAS—SAID TO BE THE WORLD'S MOST DANGEROUS.

STEVEN HOLT/STOCKPIX.COM

A THREATENED PARROT SNAKE (*LEPTOPHIS AHAETULLA*).

ruin their health for the sole purpose of discovering a new species." Risk their lives and ruin their health they did.

The expedition started by crossing the high Andes on a mountain trail, passing through the Bolivian Yungas (the jungle-covered eastern slope of the Andes), down the Bopi River by balsa raft, and to the jungle town of Rurrenabaque by way of the Beni River. They searched the Beni savannas for a lake that was rumored to have an outlet to the Beni River. There was no such outlet, so they backtracked to Rurrenabaque. Along the way, five of the eight expedition members departed for reasons that vary from disillusionment to illness. That was in the first year. The remaining members traveled to Manaus in Central Brazil, up the Rio Negro, to the Uaupes River, and finally to the Tiquie River where they were blocked by waterfalls and rapids and had to turn around. After a second full year of wandering, the expedition came apart when the final member was left to recover from poisoning in Manaus.

INTREPID EXPLORERS

Despite the fact that the expedition members were experts in their disciplines, they weren't necessarily prepared for the hardships of tropical travel. In addition to Bill Mann and Gordon MacCreagh, there was the expedition's director, H. H. Rusby, an expert on botanical drugs from Columbia University. His assistant and taxidermist was George S. McCarty. They were joined by E. N. Pearson, the expedition's ichthyologist from the University of Indiana. The final two members were Orland E. White, a botanist from the Brooklyn Botanic Garden, and F. L. Hoffman, a statistician studying the health of people living in the tropics. Among the eight, only three had previously traveled through a tropical rainforest.

The expedition must have felt like an action movie, complete with narrow escapes, large populations of unsavory insects, unknown Indian tribes, and mysterious illnesses. Stubborn mules slowed the expedition in the mountainous portions of the route. Where the trail met a rough, uninhabited stretch of river, the expedition became stranded for weeks. It was stalled again on the Uaupes River when the Indian guides spotted the footprints of a hostile tribe during a stop on the river's shore. The guides raced back to the boats with a yell, leaving the expedition members at the mercy of the much-feared tribe. Medical care on the expedition was non-existent. At one point, Mann extracted a tooth from the mouth of Rusby. There was no dental anesthetic and the tooth broke off short at the neck, "leaving the frayed nerve terminals hanging in full view." Ironically, Rusby, a medical doctor, had been in charge of outfitting the expedition.

Eighty years later, the medical care, transportation, and the maps have improved, but getting around in the Bolivian Amazon is still challenging. My traveling companions and I spent some time in the forests along the Beni and Tuichi Rivers, as well as the savanna (pampas) of the Beni. We reached Rurrenabaque by airplane, the savanna by jeep, and the rainforests by motorized dugout canoe. The jeep ride entailed five hours of pounding on a deeply rutted dirt road to reach the pampas camp. On the return trip, our jeep got a flat tire. We were lucky. Other vehicles simply drove into a muddy rut where they would be trapped until the soil dried.

Navigating the smoother, deeper sections of the Beni and Tuichi Rivers by motorized dugout canoe was not unlike river travel in North America, except for the mammoth logs that floated along with us. Making our way through the trickier shallows was decidedly low-tech. A long stick is poked into the rapids to determine the best route or to make quick steering adjustments. The same technique was used when the Mulford Expedition passed through the rapids along the Bopi and Beni Rivers, but unlike the dependable muscle power used to propel their balsa rafts, our motor power failed going both upriver and down.

THE "BUG-HUNTER"

Mann never would have been on the Mulford Expedition had his boyhood dream come true. As a child, he ran away from his home in Helena, Montana, to join the circus, but John Ringling sent him away to further his education. He wound up with a Ph.D. in entomology from Harvard and a job with the U.S. Department of Agriculture. Before the Mulford Expedition, he was a member of the Stanford Expedition to South America in 1911 and did field work in Haiti, Cuba, and Mexico. In 1926, he married Lucile Quarry, who overcame her fear of snakes to join him on collecting trips around the world

while he was director of the National Zoo. Of her husband she later wrote, "Bill is really an entomologist gone wrong. Long before he had the right to carry in his pocket the key to the tiger cage, he had spent years collecting and studying insects, especially ants.... I have seen him bend over a nest where hundreds of ants were running around in wildest confusion, and make a sudden pounce on one tiny, almost microscopic beetle that would be in their midst."

MacCreagh would also describe Mann's passion for insects, nicknaming him the "bug-hunter." When he brought samples of an ant he discovered to the bug-hunter, "Mann would name fifty ants that are cousins and nephews and poor relations of this family, and give a short history of each. But these ants are new. Neither you, my friends, nor I can quite understand the thrill attached to a new ant. But there is apparently a whole lot; also much honor. So the bug-hunter is going to name it after me."

Had his interests been strictly of the six-legged variety, Mann may never have come in contact with the National Zoo. However, he studied and collected all kinds of animals, and during his tenure at the Zoo—1925 to 1956—he was known for his showmanship and for acquiring so many new animals that the Zoo became quite crowded. From the Mulford Expedition, he collected 135 live animals, many of which were delivered to the National Zoo.

Ironically, the director of the Mulford Expedition did not want any living creatures to be collected on the trip. Traveling with live animals through river rapids and unknown camps was not what Rusby had in mind when he organized the trip. But, it was not long before he changed his position. According to Mann, "...when a baby paroquet of delicate green hue and a confiding disposition perched on his finger, his outlook toward live things changed, and from then on we had *carte blanche* to collect anything possible."

A FLOATING MENAGERIE

Surprisingly, collecting live animals in Bolivia in 1921 didn't require traps or nets, but trade. Many rainforest animals are kept as pets or captured for food by local Indians, and even beloved pets can be bought for the right price. Finding settlements or meeting people on the rivers and trails became the most fruitful way to build their animal collection.

In Huachi, the first "specimen of importance" was obtained. In exchange for a handful of salt, Mann got a mealy parrot (*Amazona farinosa*) from a group of Indians who had walked twelve days through the rainforest. These large, green birds are still common enough to almost guarantee a sighting on any trip to a Central or South American rainforest. But, despite their extensive range, they do not favor deforested landscapes.

Also in Huachi, the expedition members obtained a baby tapir, which they named Billy. He traveled with the expedition for a number of months and apparently had a personality that was simultaneously obnoxious and hysterically funny. He particularly liked to chew on boot laces, whether or not they were attached to busy feet. He successfully traveled by raft down rapids, but it was calm-water travel by launch that led to his demise. The boat's engine whistle panicked the tapir and, after several days of blowing, he stopped eating. In an attempt to cure Billy, the expedition's cook gave him an unknown pill and he was dead the next morning. It is not surprising that the sharp, unfamiliar sound of an engine whistle was so startling to a tapir. Despite the fact that these animals are the largest in the Amazon, they are reclusive, nocturnal, and surprisingly difficult to spot. Walking in the rainforests along the Tuichi River, we saw tapir tracks everyday, but somehow these large, lumbering animals eluded us.

Rurrenabaque was the site of the expedition's longest stop and the collection point for many specimens. Today it functions as a staging ground for eco-travelers in search of wildlife and adventure. It is a spectacular sight to enter Rurrenabaque by boat from upriver. As MacCreagh observed, "The hills ended abruptly... then through a narrow gorge with precipitous sides, as though a giant door.... there in front of us lay the endless plains which stretch away eastward into Brazil and southward into Argentina. Behind us a cliff wall, like our own Hudson River Palisades, at the very feet of which nestled the fifty or so wattle-and-daub houses of the town on Rurrenabaque." The narrow gorge is now the grand entrance to Madidi National Park. Rurrenabaque is larger today, but the housing has probably not changed dramatically since the

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BRENDA CLYMIRE/NZP

JESSIE COHEN/NZP

JAGUAR (*PANTHERA ONCA*). CRIMSON-RUMPED TOUCANETTE (*AULACORHYNCHUS HARMATOPYGUS*). SPECTACLED BEAR (*TREMARCTOS ORNATUS*) AT THE ZOO.

THE EXPEDITION MUST HAVE FELT LIKE AN ACTION MOVIE, COMPLETE WITH NARROW ESCAPES, LARGE POPULATIONS OF UNSAVORY INSECTS, UNKNOWN INDIAN TRIBES, AND MYSTERIOUS ILLNESSES.

Mulford Expedition.

As Mann observed, Rurrenabaque is at the intersection of three major ecosystems—the mountains, the rainforests, and the pampas. The result of this blending is a remarkably high diversity of wildlife, as revealed in the variety of animals collected during their long stay there. In Rurrenabaque, the hot trade item was medical supplies. Upon arrival, the expedition members were quickly overwhelmed with requests for various pills and medical procedures. In response, they bartered quinine pills or iodine for one parakeet, parrot, or small monkey; larger, rarer animals were required for taking care of a laceration. Before long, the expedition members hosted to a courtyard full of animals.

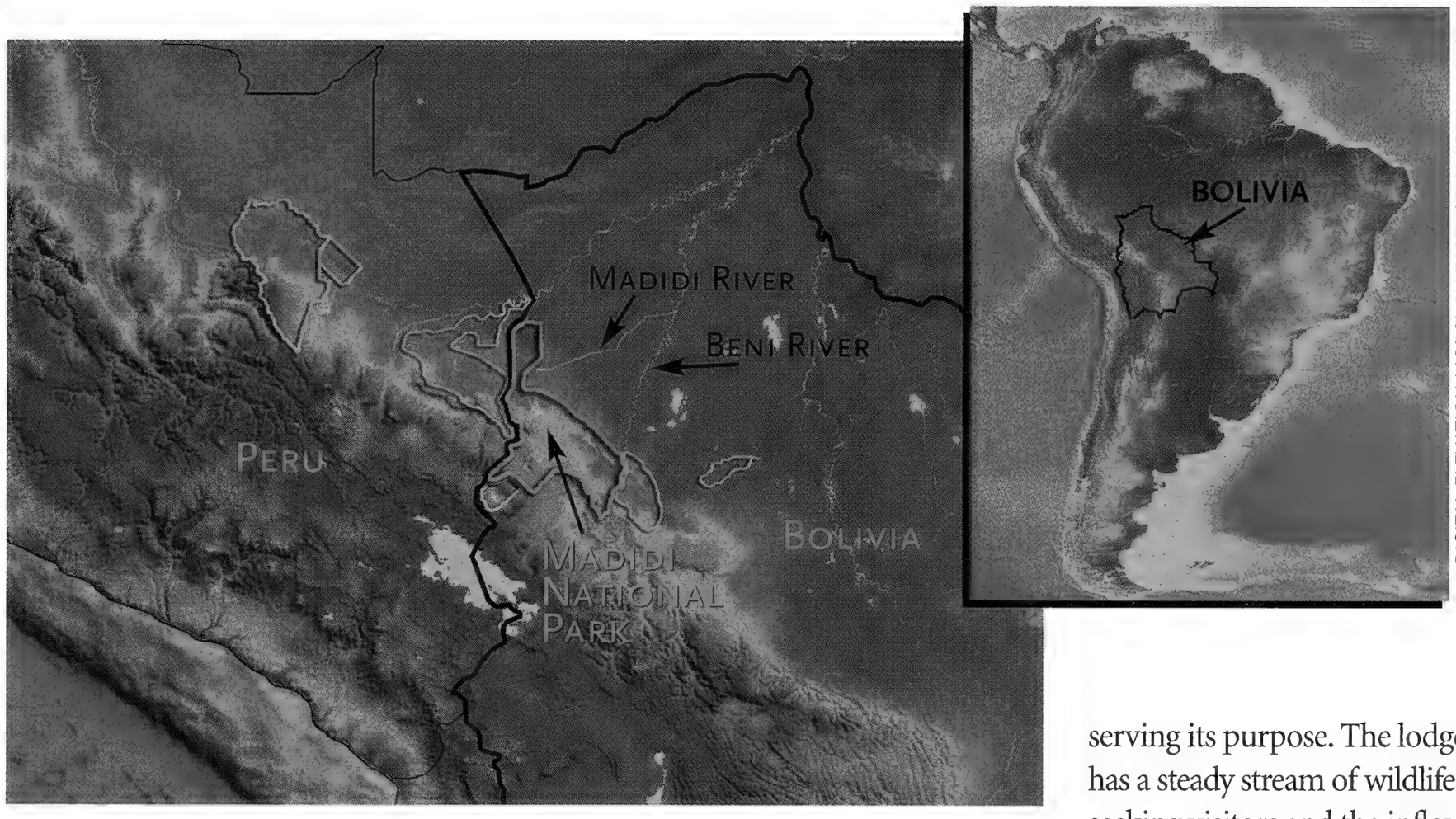
At Rurrenabaque they collected greater rheas, the South American equivalent of an ostrich. Rheas are scruffy, flightless birds that live on the pampas. Despite the fact that they are large-bodied and stand up to five feet tall, they can be difficult to spot. The pampas grasses are also tall, leaving only the rhea's thin neck and head exposed like a camouflaged hand puppet above a toy stage.

Rheas and African ostriches are believed to have descended from a common ancestor when the two continents were connected as part of Gondwanaland. Rheas also have some unconventional behaviors as well. The male copulates with several females, builds a nest, and convinces all his mates to lay the eggs in the group nest. He then incubates the eggs and raises the chicks.

MacCreagh made a prophetic observation about the rhea's habitat in 1921. He wrote, "Some say that when communications open up, the Bolivian pampas will be a rich cattle country." Whether 80 years would be considered far in the future is debatable, but the future in the pampas has arrived. The road from Rurrenabaque to the heart of the pampas has several rustic cell phone towers and the land is riddled with cattle ranches.

One type of bird that Bill Mann coveted was the flower-headed caique also called the yellow-thighed caique. These colorful birds were apparently valued by the locals as pets and they were not easily persuaded to give them away. In Riberalta, they found a women who owned four as pets. She was willing to trade the birds for money to buy a new dress, but her husband forbid it. One day, she sent word that she could trade the birds while her husband was out. The husband arrived just as Mann was leaving with the birds and a "shrill-pitched argument" broke out between husband and wife. Regardless, Mann considered the birds worth the price of

TOCO TOUCAN (*RAMPHASTOS TOCO*).



THE MULTINATIONAL CORRIDOR OF BIOLOGICAL RESERVES (YELLOW) INCLUDES MADIDI NATIONAL PARK, AS WELL AS OTHERS IN PERU AND BOLIVIA.

DIGITAL ELEVATION MODEL BY EARTHSTAR GEOGRAPHICS; MAP PRODUCED BY AMAZON GIS PROGRAM/NZP

a family dispute.

While much of the savanna is now being used to graze cattle, settlers have largely bypassed the nearby rainforests. It is likely that I was treated to some of the same sounds and sights the expedition members experienced. Every morning, red howler monkeys made deep, guttural howls and, at sundown, hoatzins (a bizarre bird whose young have clawed wings), squawked in loud bunches along the waterside. The raucous chatter of macaws and parrots periodically penetrated the constant drill of cicadas. A jewel-like dung beetle, in particular, captured my attention. Its beautiful exterior seemed inconsistent with the job it performs in the rainforest—consuming the dung of other animals. We also saw capybaras, a bright green parrot snake, toucans, and delicate butterflies.

BACK TO THE FUTURE

In 1990, a team of scientists working with Conservation International tried to get a handle on what animals and plants inhabit the lowland and montane forests of the area. As part of their Rapid Assessment Program, the scientists tried to document all the species they could locate within a span of several weeks. What they found was astounding. In two weeks, they identified 403 bird species, nine of which had never been recorded in Bolivia. (The scientists believe that there may be as many as 1,100 bird species in the area.) There were 45 species of mammals, including the little big-eared bat and a spiny tree rat, which had never been found in Bolivia before. The abundance of amphibian and reptile species is equal to other parts of the world considered to have a "megadiversity" of these animal groups. The plant life was equally rich. In just one-tenth of a hectare, 204 species of plants were identified, many more than in comparable moist forests elsewhere. The final report concluded that this area of Bolivia is one of the most biologically diverse in the world.

The results of the Rapid Assessment convinced the Bolivian government to establish Madidi National Park in 1995. The park is home to 85 percent of the bird species in Bolivia (11 percent of all the bird species in the world), 75 percent of Bolivian mammal species, and 40 percent of Bolivian reptile species. Endangered jaguars, giant otters, spectacled bears, and black caiman all roam within its forests. But, Madidi is not only important because of the rich biodiversity it protects within its borders, but because it is now part of a series of protected areas that stretch across international lines and an eclectic variety of habitats. According to David Ricalde, an independent conservation consultant with 15 years of experience in Peru's and Bolivia's rainforests, "We helped create a sort of a large and unique biological corridor that today includes the Manu, Tambopata, Bahuaja Sonene, Madidi, Ulla Ulla, and Pilon Lajas protected areas. In other words, there is no other more complete array of protected ecosystems like this long bi-national corridor on Earth."

Madidi, like other protected areas in the Amazon, will survive only if the people who live in and around the park have an incentive to keep it protected. Even before the park enveloped their community, the residents of San Jose de Uchupiamonas were searching for ways to keep their inhabitants from leaving for better opportunities elsewhere. Their idea was to establish an ecolodge that would draw tourists interested in viewing Madidi's abundant wildlife. With the help of Conservation International and the International Development Bank, Chalalan Lodge was opened in 1999 along the shores of a sapphire lagoon in the middle of the rainforest. Half of the profits from the lodge are shared with the San Jose community while the other half goes toward operating expenses. Chalalan seems to be serving its purpose. The lodge has a steady stream of wildlife-seeking visitors and the inflow of money means the San Jose community now has a school and a hospital. People who left the community are now returning to reap the benefits of ecotourism.

Despite Chalalan's apparent success, all is not perfect in the rainforests that border the Beni River. A proposed dam across the Beni at the entrance of Madidi National Park would flood Chalalan Lodge and surrounding rainforests. The proposal seems to be on hold for now, but there are road projects in the works and two companies hold concessions to search for and extract hydrocarbons within the park's boundaries. Development pressures will likely be an ongoing issue. Large, untouched expanses of land in the tropics rarely escape the notice of settlers and developers.

Bill Mann and the other members of the Mulford Expedition knew that leaving the well-traveled world and entering the unknown was not only a great adventure, but the best way to discover new species, new medicines, and new routes. Even 80 years later, some of the areas they traveled are still relatively unstudied by scientists. It's entirely possible that a leisurely hike along a jungle path can reveal a new species or two. It's this potential that makes some of us, whether we are scientists or simply animal lovers, leave our comfortable lives to follow "strange tracks" and "far-away calls."

—Terry Dunn is a freelance writer, environmental educator, and artist living in Albuquerque, New Mexico.

The Zoo's Amazon GIS is a mapping resource that can be found on the Web at http://AmazonGIS.org

JESSIE COHEN/NZP

PYLLOBATES TERRIBILIS A TRUE POISON-DART FROG.

BRIDE-RS of the FoRE-ST CURE-S

BY JOHN TIDWELL

DENDROBATES LEUCOMELAS— THE YELLOW-BANDED POISON-ARROW FROG.

The Indians had found something. The bearded American scientist stopped scribbling notes and moved quickly through the riot of tropical foliage while shouts of "Kokoe!" echoed ahead of him. Mist was spreading over western Colombia's mountainous Choc o region, one of the wettest places on earth and home to mysterious creatures the indigenous Embera peoples called Kokoe. The animals' skin is so poisonous, the Indians say that an arrowtip touched to it would become deadly for months—excellent for hunting. Donning a glove, the American biochemist from the National Institutes of Health hustled up to the stream where several muscular hunters were clustered. Scooping up the source of the commotion—a bright orange, half-inch-long frog that regarded him with black, unblinking eyes, John Daly smiled beneath the broad brim of his hat. *Phyllobates terribilis*, he mused, perhaps the deadliest animal on earth, as well as a potential treasure to medical science!

The natural world is the origin of most of our medicines and remains alluring to scientists and to pharmaceutical companies alike, each seeking new and unknown drug sources. It's tantalizing to think that the cure for AIDS or cancer could be out there, in the biochemical bouquet of a rainforest flower or the venemous sting of a reef snail in the sea.

Or maybe the next pharmaceutical bestseller might be sloshing in the calabash of some obscure village shaman. The wilderness that was once considered useless is now seen as a vast genetic frontier, chock-full of species with a nearly infinite variety of biochemical weaponry, hammered into unique forms over the millennia by the forge of natural selection. Smithsonian entomologist Terry Erwin has estimated that there may be greater than ten quintillion different insect species on Earth, more than anyone could catalogue in a lifetime.

Today, with a global pharmaceutical market worth hundreds of billions of dollars, it has become clear to drug companies, large and small, that natural products from remote places may lead to fortune and glory. According to a study by Scotland's University for Drug Research, nine of the 20 top-selling pharmaceuticals worldwide are derived from natural products, with profits reaching beyond $16.5 billion in 2001. Taxol, discovered in 1967 in the bark of the Pacific Yew tree (*Taxus brevifolia*), has not only become the number one treatment for breast and ovarian cancer, but has generated close to $2 billion dollars in sales last year.

The quest for medicinals from animal and plant species has mushroomed since the 1960s and over a hundred major drug companies are now "bioprospecting." Some companies, like California's Shaman Pharmaceuticals, have focused entirely on seeking cures in the folk remedies of indigenous peoples, convinced that the "Philosopher's Stones" of medicine could be found in their dying arts. Today, hunting for new medicines has proven to be more scientifically frustrating and politically volatile than most bioprospectors ever envisioned when they first ventured out into the wild.

PROSPECTING AND PIRACY

When Steven Speilberg brought Indiana Jones to the screen in the 1981 film *Raiders of the Lost Ark*, he gave name and identity to the archetypal scientist–explorer. Later films, like *Medicine Man* (1992) and *The Serpent and the Rainbow* (1987) that were based on the real-life bioprospecting adventures of ethnobotanist Wade Davis, reinforced the image of the swashbuckling American adventurer. But seen through the eyes of the indigenous peoples whose temple he has just raided, the heroic Indiana suddenly looks like a thief.

Like the cinematic Dr. Jones, scientists have long thought they had the right to take animal or plant samples from the field for study. In fact, recording folk traditions or bringing back a dollop or two of a shaman's magical concoctions was not only considered good science, it was (and still is) absolutely necessary to understanding the culture. Back in the 1970s when John Daly wanted to learn how poison-dart frogs made their toxins, he didn't hesitate to collect scores of them from many different South American countries, boxing them up and mailing them back to his lab in Bethesda, Maryland. This was how scientific work was done, and most countries had no laws against the export of plants or animals for scientific purposes. Everyone assumed the indigenous peoples didn't care. Big profits from these samples were also not part of the equation back then because scientists couldn't modify complex toxin molecules or produce mass quantities of a drug from a small field sample.

But by the end of the 1970s, the biological revolution was rolling, and together with rapid advances in computer science and instrumentation, scientists had the tools not only to "see" molecules more clearly, but to change their chemical structure, making them more or less potent as needed. The routine modification of small molecules, such as the alkaloids found in poison-dart frogs, and of organisms, by introducing new or modified DNA, has since followed. By June 1980, the Supreme Court had ruled that genetically engineered living creatures could be patented and owned. Not only was this a major step for science, it changed all the rules of medicine hunting. Suddenly, there was a much greater potential to profit from "wild" drugs and collected genetic diversity. What was once a fairly arcane field of science became the high-stakes game of bioprospecting.

At about the same time, conservation groups and nongovernment organizations (NGOs) began a serious campaign to save the rainforests of the world from logging and strip-mining. They began to promote rainforest products that could only exist if the jungle was left alive and healthy. While some groups made efforts to sell Brazil nuts and shade-grown coffee, ethnobotanists like Mark Plotkin began promoting the Amazon and

SOUTH AMERICAN ORCHID.

MARK PLOTKIN/THE AMAZON CONSERVATION TEAM

A South American hunter encountered by Mark Plotkin.

MARK PLOTKIN/THE AMAZON CONSERVATION TEAM

other rainforests as a vast pharmaceutical cornucopia. In *Tales of a Shaman's Apprentice*, Plotkin made the case that the rainforest might be home to thousands of as-yet-undiscovered plant and animal species that produce chemicals key to defeating disease. The campaign was popular, especially among pharmaceutical companies. During the 1980s and '90s, every major drug company from AstraZeneca to Roche began bioprospecting projects in the Amazon and around the world, racing each other to be the first to stake a claim on the next Taxol. And not all the players were as principled as Plotkin and other conservationist.

ILLICIT PROSPECTING

It wasn't long before rumors emerged of secret exports avoiding customs, of scientists planning to arrive in remote villages aboard armed military helicopters, and of companies making millions from herbs swiped from shamen. Some Brazilian scientists claimed more than 20,000 plants were being taken out of the country by foreigners every year, with no efforts to compensate the indigenous peoples or the Brazilian government. Many accounts were unsubstantiated, but surely many were legitimate.

In 1974, an American pharmacology grad-student named Loren Miller brought a medicinal Ayahuasca vine (*Banisteriopsis caapi*) home from Ecuador and began cultivating it in Hawaii. In 1986, he got a U.S. patent and created the International Plant Medicine Corporation to market it. The hallucinogenic Ayahuasca is one of the most sacred plants for many Ecuadorian Indian tribes, one which shamans have used for centuries for healing and divination. When the tribes found out about Miller's patent in 1994, they were outraged, declaring Miller an "enemy of indigenous people" and threatening to kill him if he returned. Most of the developed world said this wasn't theft, it was business—unsavory perhaps—but business. Molecules and genes in plants and animals down to the smallest microbe were now patentable. But as more cases of hard-ball-capitalist bioprospectors emerged, indigenous peoples joined forces with human-rights NGOs to mount a legal bulwark against what they called biopiracy.

The movement culminated in 1992 with the United Nation's Convention on Biodiversity (CBD), an agreement signed by 144 countries at the Earth Summit in Rio de Janeiro. Simply put, the CBD gave nations sovereignty over their genetic and biological resources and entitled them to "fair and equitable sharing of benefits" from their exploitation. It also recognized the rights of indigenous peoples to their traditional knowledge, and that any use of that knowledge should require their permission. Most of the developing nations of the world ratified the treaty. Most of the developed nations, including the United States, did not, stating that they were concerned it would harm the biotech industry. But while the CBD was an inspirational gesture that provided a legal framework upon which countries like Ecuador or the Philippines could build laws against ruthless bioprospecting, it was grandly ignored by both the scientific community and the developed world. Nevertheless, a political line in the sand had been drawn—nothing would be the same again.

JESSIE COHEN/NZP

Dendrobates azureus species of frog used in John Daly's feeding studies.

BIOPIRACY EXPOSED

In the late 1990s, a British biochemist named Conrad Gorinsky was studying the folk cures of the Wapishana Indians, who live on the border of Brazil and Guyana. He then took out patents on bioactive compounds found in two of the Indian's traditional medi-

LIFE FROM THE DEADLY

JOHN TIDWELL

The Vodoun sorcerer finished praying and, with nose-plugs still in place, poured the brownish mixture from his mixing calabash into a small mason jar and handed it to the young American squatting by the fire. The sorcerer's dark eyes twinkled as he watched Wade Davis turn the jar in the first rays of dawn. This was it at last: Zombi powder!

When Harvard ethnobotanist Wade Davis went to Haiti alone in 1982 and persuaded several Vodoun sorcerers to show him how to make a powder they said helped turn people into the "living dead," he was not only hunting for a new kind of an anesthetic— he was also following a venerable tradition in Western science. Most of the time, plants and lower forms of life were the focus. But today bioprospectors are widening their scope to include the chemical weaponry of animals. "The new frontier for natural-product development right now is poisons," says ethnobotanist Mark Plotkin. These come from such animals as Central and South American poison-dart frogs or from cone snails in the Philippines.

DAVID B. SWIDER

In recent years, biochemists have examined venoms from a huge variety of animal species from insects to amphibians and reptiles, seeking unique effects on the nervous and cardiovascular system. Whether for defense or hunting, millions of years of evolution have produced animal toxins to stop prey or predator quickly—and often permanently. Even more intriguing, many of these species have their own unique recipe, usually specific to the physiology of its target. According to University of Utah biochemist Baldomero Olivera, there are more than 500 species of marine cone snails in the Philippines, and each one uses a different configuration of deadly peptides (or short proteins) to catch fish. Other creatures, like John Daly's poison-dart frogs, are thought to get their poisonous alkaloids, called batrachotoxins, from something they are eating (what that is remains a mystery).

Wade Davis discovered that the viscera of two tropical puffer-fish species, *Diodon hystrix* and *Sphoeroides testudineus*, were a key ingredient in Haitian zombi powder. These fish are members of the family Tetraodontiformes, which includes triggerfish, ocean sunfish, and porcupinefish, all known to sequester a deadly neurotoxin from a species of red algae. Like batrachotoxins, a pinhead-size amount can be lethal to human-size animals, and both kill by blocking nerve signals, causing paralysis and heart failure within seconds.

Although most compounds are still experimental, biochemists are able to turn these molecular swords into medical ploughshares, refining biological compounds into drugs that act to extend life rather than end it. A Canadian company called Thor Ventures wants to develop tetrodotoxin into a treatment for heroin addiction called Tetrodin. The poison of the five-inch giant Israeli scorpion (*Leiurus quinquestratum*), known as the "death stalker" throughout the Middle East, was found to contain a peptide called chlorotoxin, which targets cancerous glioma cells in the brain and stops them from spreading. The bite of the huge Cameroon red tarantula (*Hysterocrates gigas*) can immobilize prey as large as birds and small rodents. The toxin, which blocks calcium channels in nerves, is in preclinical development by Neurex, an American drug company, as a treatment for acute pain.

Olivera has discovered many venom peptides from cone snails that he has called conontoxins. These are currently the focus of clinical trials under the name Ziconotide, which is hoped to be non-addictive treatment for chronic pain. A team from the University of Melbourne led by Bruce Livett recently announced the patented discovery of one conotoxin, called ACV1. Early results suggest the potential pain killer may be 10,000 times more powerful than morphine, and some believe it is non-addictive.

Among other deadly bites, the toxin of the Colombian fer-de-lance viper was discovered to have anti-coagulant properties that could be used in stroke victims to prevent blood clots; the monacled cobra's poison prevents immune cells from stripping myelin from nerve cells and could be used to treat multiple sclerosis. Even the dreaded Gila monster of the American Southwest has compounds in its venom that are being studied for the treatment of diabetes and other metabolic disorders.

"BIOPROSPECTING IS LIKE WAKING UP IN THE NIGHT TO FIND ROBBERS IN YOUR HOME WITH A BAG FULL OF YOUR POSSESSIONS."

cines: Tipir (which he renamed Rupununine), an antibiotic from the seeds of the endangered greenheart tree (*Ocotea rodiaei*), and a polyacetylene compound that he dubbed Cunaniol, from the leaves of the barbasco bush (*Clibadium sylvestre*), which apparently was a powerful neuromuscular stimulant. By the time the Wapishana found out what Gorinsky had done, he had already formed a partnership with a Canadian venture capital company to market "his" new drugs.

When the Indians tried to sue the 55-year-old scientist, they discovered that his actions were all perfectly legal. "I don't owe them anything," Gorinsky said. "I made all the intellectual effort and spent thousands of dollars out of my own pocket. Would the Indians ever invest in this?" he announced in the Brazilian press. This kind of denial of wrongdoing was a defiant stance that scientists and drug companies had used with some success many times in the past. But in the years since the CBD was formed, the legal and political landscape had changed, with countries, NGOs, and indigenous peoples challenging bioprospecting claims as never before.

With help from local and U.S. NGOs, the Wapishana mounted a legal protest that grew into political arm wrestling between England and Guyana. In the end, the British Patent Office dropped Gorinsky's claim to Cunaniol (officially they said it lacked novelty). Accused of biopiracy by four other countries where he had worked, Gorinsky now stands to lose his other patent, as well as his reputation as a scientist. Similarly, in 1999, Ecuadorian tribal leaders and representatives of more than 400 other South American tribes came to Washington, D.C., in full traditional dress to demand the U.S. drop Loren Miller's patent on Ayahuasca. The political theatrics worked, and the U.S. Patent & Trademark Office revoked what it called Miller's "flawed patent."

PROSPECTING BACKLASH

Over the past five years, such NGOs as Action Aid, GRAIN (Genetic Resources Action International), and ETC (Erosion Technology and Concentration group, formerly RAFI) have begun a concerted campaign against bioprospecting of any kind. Wherever they perceive biopiracy has occurred, these organizations assume the role of advocate for indigenous peoples, accusing the corporations of "illegal, immoral, and unethical" practices, threatening them with product boycotts back home and scuttling deals that have often taken years and millions of dollars to arrange. For these true believers, there is no difference between bioprospecting and biopiracy. "Bioprospecting is like waking up in the night to find robbers in your home with a bag full of your possessions," explains Alejandro Argumedo, head of the Indigenous People's Biodiversity Network, "And when you ask them what's going on, they reply, 'Don't worry, we have a proposal for benefit-sharing!'"

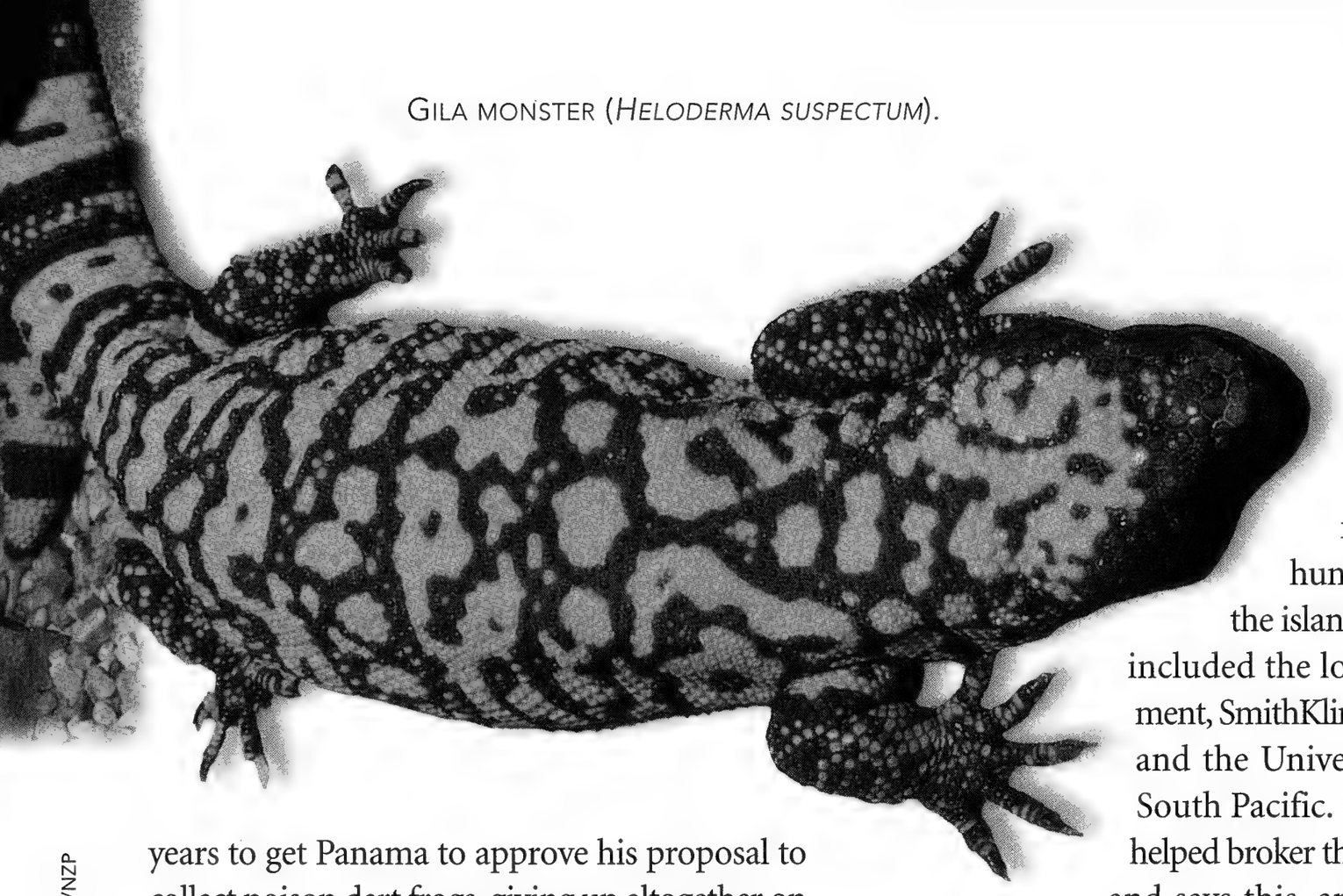
Developing countries have also begun to put legal muscle behind the CBD's moral commandments. A few years after the Rio Convention, the Philippines was the first country to create laws that required bioprospectors to collaborate with local scientists, get the consent of indigenous peoples, and provide compensation to the government. In 1997, Brazil enacted similar laws, and shortly thereafter arrested scientists from Switzerland and Germany who tried to take field notes and samples out of the country without official permission. Today most South and Central American countries have erected such legal barricades and tend to view every scientist or drug company as Cortez in disguise.

VALERIE C. CLARK/COLUMBIA UNIVERSITY

Dendrobates leucomelas, a close relative of the *Dendrobates azureus* frog used in Daly's feeding experiments.

Scientists have been understandably upset. While most favor sharing drug profits with local governments and peoples, many biochemists blame the CBD and its resultant fears of biopiracy for a chilling effect on field research. "When the world mentality was that natural resources were common ownership, there was a fertile utilization of natural resources for drug discovery," said William Fenical, director of University of California, San Diego's Center for Biotechnology and Biomedicine in a 1999 *New York Times* article. The Rio Convention destroyed that, he says. It took Fenical four years to get the Philippines to give him permits to hunt for a species of bioactive coral, and when he arrived, they revoked the permits and charged his partner, Bristol-Meyers Squibb, $600,000 in penalties—because, they said, Fenical did not "go through the whole process."

Once a medicine-hunting playground, the Philippines now has some of the toughest regulations, approving only two out of 37 bioprospecting proposals, according to a Columbia University study. Andes Pharmaceuticals was rejected by the Colombian government because their proposal was not specific enough about which plant species would be collected. British researchers at Portsmouth University had to return 120 bottles of marine fungus to Thailand because they were not collected with proper permission years before. It took John Daly three



GILA MONSTER (*HELODERMA SUSPECTUM*).

JESSIE COHEN/NZP

years to get Panama to approve his proposal to collect poison dart frogs, giving up altogether on Venezuela. Practically every major pharmaceutical company has been accused of biopiracy in recent years, as well as prominent scientists like Daly. In fact, the charge has been used so often and so indiscriminately, that intellectual property lawyer Michael Gollin says, "If you haven't been called a biopirate at one time or another, you haven't been active enough in the field."

Pharmaceutical companies, always sensitive to public opinion, have reacted with a number of strategies to save face and keep prospecting, including targeting plants and animals that indigenous tribes don't use, a practice that limits chances of success. The ETC says another approach big drug companies use is to let a smaller company make the deal with shaman. Then the big company buys promising compounds from the little one. NGOs claim that drug companies have also been covertly using middlemen in the field to obtain samples. In the past, the people on the ground have not necessarily been company employees, but intermediaries, says Hope Shand, Research Director for ETC group. Drug companies play governments against each other, or against their indigenous peoples, to get the best deal, especially if the desired organism occurs in more than one region. Shand points to one case in which a team from the National Institutes of Health wanted to do some bioprospecting in the Philippines but were denied. So they struck a deal with Vietnam and Laos instead. However, the question remains, is this biopiracy, as ETC claims, or just smart shopping?

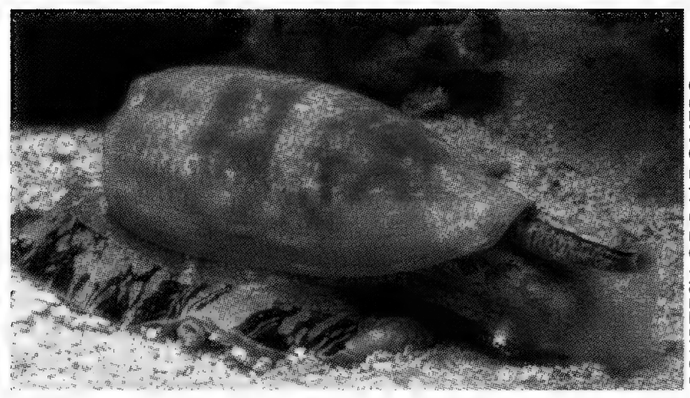
In recent years, many pharmaceutical companies have made strident efforts to be as open and fair as possible, making deals that meet every government requirement, with benefit-sharing plans for those involved. This strategy worked beautifully for a medicine-hunting deal on the island of Fiji that included the local government, SmithKline-Beecham, and the University of the South Pacific. Gollin, who helped broker the agreement and says this, and a similar project on Samoa, stand out as shining examples of bioprospecting projects that are above-board and respectful of the rights of all parties.

MARK PLOTKIN/THE AMAZON CONSERVATION TEAM

A NATIVE HELPS SCIENTISTS COLLECT FIELD SAMPLES.

UNCERTAIN PROSPECTS

Unfortunately, such successes have been few. Contrary to the claims of both bioprospecting boosters and foes, finding medicines in the wild is often neither simple nor profitable. While there have been some stellar discoveries like novocaine from the coca plant, aspirin from willow bark, and cortisone from wild yams, comparatively few drugs have resulted from bioprospecting in recent years. Merck spent seven years and $1 million courting Costa Rica to get access to its rainforest, and never found anything worth developing.



COURTESY OF BALDOMERO OLIVERA/ PHOTOS BY K. S. MATZ.

CONUS GEOGRAPHUS, A FISH-HUNTING CONE SNAIL THAT HAS KILLED PEOPLE.

Biochemists say that while NGOs roar about the lack of profit sharing when a company finds a spicy new compound, they fail to take account of the long and arduous process it will have to undergo before the drug makes it to the marketplace—if it ever does. A bioactive compound may show potential, but that is no assurance it will make it through clinical trials, much less become a pharmaceutical best-seller.

It can often take 15 years of analysis, refinement, and three levels of human trials before a new drug is approved in the U.S., and at that point it may bear only a slight resemblance to its natural form. Ziconotide, a treatment for severe epilepsy found in the toxin of Philippine cone snails (*Conus* spp.), was turned down last year by the FDA after going through the entire process, and must now go through further tests before being reviewed again. Many drug companies spend huge amounts of time and money on prospective drugs, only to discover that its molecule was the wrong size or just too costly to synthesize. This should not be too surprising; after all, these natural compounds evolved as defenses to specific ecological threats, not to suit human needs. Sometimes the molecule is too fragile or too big to be easily copied, or the venom is too powerful—or not powerful enough—to be useful to humans. Botanist Christopher Robbins of the World Wildlife Fund says, "It's basically a shot in the dark… pharmaceutical companies throw out a large net and try to pull in everything they can find." In all, perhaps one out of 10,000 species proves to be commercially viable, Robbins estimates.

There is also the cost of developing a drug. A favorite biopiracy example cited by NGOs is that of vincristine and vinblastine, two anti-cancer drugs discovered in Mexico by Eli Lilly in 1954. The compounds were found in a plant that is common to most nurseries and backyards and originally came from Madagascar more than 100 years ago: the rosy periwinkle (*Catharanthus roseus*). While Lilly has made an estimated $100 million per year from these alkaloids, Madagascar was never given a dime in return. Proponents say those who cry foul don't take into account the

HAROLD COGGER/AUSTRALIAN MUSEUM

AUSTRALIA'S ENDANGERED SOUTHERN CORROBOREE FROG MAKES ITS OWN TOXINS.

years and money Lilly invested in the development of these drugs. In the 1950s, it cost about $40 million to bring a single medicine to market. Today it's close to $500 million. After 30 years and more than $200 million in investment capital, Shaman Pharmaceuticals, the "great white hope" of rainforest medicinals, only developed one drug, an anti-diarrheic. Last year, the company filed for bankruptcy because it couldn't afford to put drugs through the FDA approval.

SCARLET LETTER

The more one explores the issues of biopiracy, says Gollin, the more it seems to be about politics rather than economics. The brand of biopiracy now carries a stigma of criminality that, true or not, is very hard for companies to shake. Partners become skittish, investors bail out, and the public begins to view the corporate product with a suspicious eye. Sometimes the accusation alone is enough to kill a pharmaceutical project or halt a drug's development. In 1998, a consortium of U.S. and Mexican universities and government agencies tried to launch a $2.5 million bioprospecting project with the Maya from the southern Mexican state of Chiapas. Brent Berlin, the project's leader and a noted anthropologist, and his colleagues went to great lengths to address every concern, obtain every permit, and assuage every fear in order to examine the folk medicine of the Maya for possible development. But not all the Maya were happy with the arrangement. ETC (then RAFI) took up their cause and publicly leveled charges of biopiracy at the project. The whole thing collapsed shortly thereafter.

Berlin remains bitter, not just because his project was halted before anything was even found, but because he feels ETC attacked the wrong bioprospectors. "Sure there are bad guys out there," he says, "but who is the first target when these people start screaming 'biopiracy'? We are.... It's not the folks who are out there doing it surreptitiously.... It's the folks who are trying to do it right." John Daly agrees, pointing out that he has been accused of biopiracy and, after 40 years, neither he nor Abbott Labs, who is trying to develop a synthetic compound based on poison-dart-frog poison, have made a cent on these alkaloids. Conrad Gorinsky and Loren Miller have not either.

The very definition of biopiracy begins to unravel when put under the legal microscope. Despite admonishments by NGOs, their supporters, and even the CBD, bioprospecting and even what could be considered biopiracy, is not a crime in most parts of the world. "There is no legal term for biopiracy," says Gollin. "So if a company's actions don't need to be illegal to be called 'biopiracy' then what is biopiracy? It begins to mean whatever you want it to mean," he concludes. This is not to say, he explains, that taking natural resources out of a country, be they toxic frogs or raw diamonds, without official permission is legal—it very definitely is not. But when bioprospecting is done with the permission of both governments, sabotaging it is not so much a legal issue as a political act.

The political agenda of ETC is the recognition and respect for the rights of indigenous peoples. Some NGOs have made the case that biopiracy is an intellectual property issue, and should be addressed by international law. But according to Robert Boherer, Professor of Law at California Western School of Law, national sovereignty ought to be enough to protect the natural resources of a country and its indigenous peoples—if that is what the ruling government wants to do. From this perspective, charges of biopiracy have more to do with political powerplays than medicines and intellectual property. Sadly, the real victim in this drama may be science. What future bioprospecting has may be a question that no one can yet answer.

—John Tidwell is a freelance journalist living in Silver Spring. He has written numerous articles on conservation issues for ZooGoer, *as well as articles on history for* American Heritage *and* American Legacy *magazines.*

A VERY SPECIAL TOAD

Until recently, any biochemist who studies natural toxins would tell you that the only organisms that can create their own alkaloid poisons are plants and lower animals. Nothing with a backbone, certainly. (Snake venom, an exception to the rule, is actually modified saliva protein). Toxic stars like the poison-dart frogs of South America, the pitohui (*Pitohui dichrous*) and blue-capped ifrita birds (*Ifrita kowaldi*) of New Guinea use tetrodotoxin, which they get from more primitive creatures—usually something they eat. That was until frog master John Daly announced at the annual meeting of the American Chemical Society last April that his team had discovered an animal that really did make its own "witch's brew" of alkaloids.

In the alpine and semi-arid forests of southwestern Australia lives a brightly colored family of toadlets that belongs to the genus *Pseudophryne*. Long known to be poisonous, these toadlets are often emblazoned with black-orange or black-yellow patterns. It has been assumed that the chemical cocktail that oozed from their skin when they felt threatened was, like all others, sequestered from their crawly dinner.

In the 1980s, Daly and his team had identified the chemical structure of the toadlet's unique alkaloids, which he dubbed pseudophyrnamines. "What puzzled us was that we never found this compound in any of the other hundreds of species of Australian frogs—or frogs anywhere else in the world," says Daly. Working with biologists at Australia's Adelaide University, Daly compared the skin toxins of eight wild toadlets with those of 18 that had been born in captivity and fed an alkaloid-free diet. He found that wild frogs had high levels of the same pumiliotoxin found in many Australian frog species, but only trace amounts of its own particular pseudophyrnamine alkaloids. The captive frogs, by contrast, had high levels of pseudophyrnamines, but no pumiliotoxins. This could only mean that the toadlets got their pumiliotoxins from something they ate in the wild, but they made their own pseudophyrnamines! Now Daly is studying how these pseudophyrnamines are able to block certain nerve receptors in the hope that the toxin might be useful against chronic pain and heart arrhythmias.

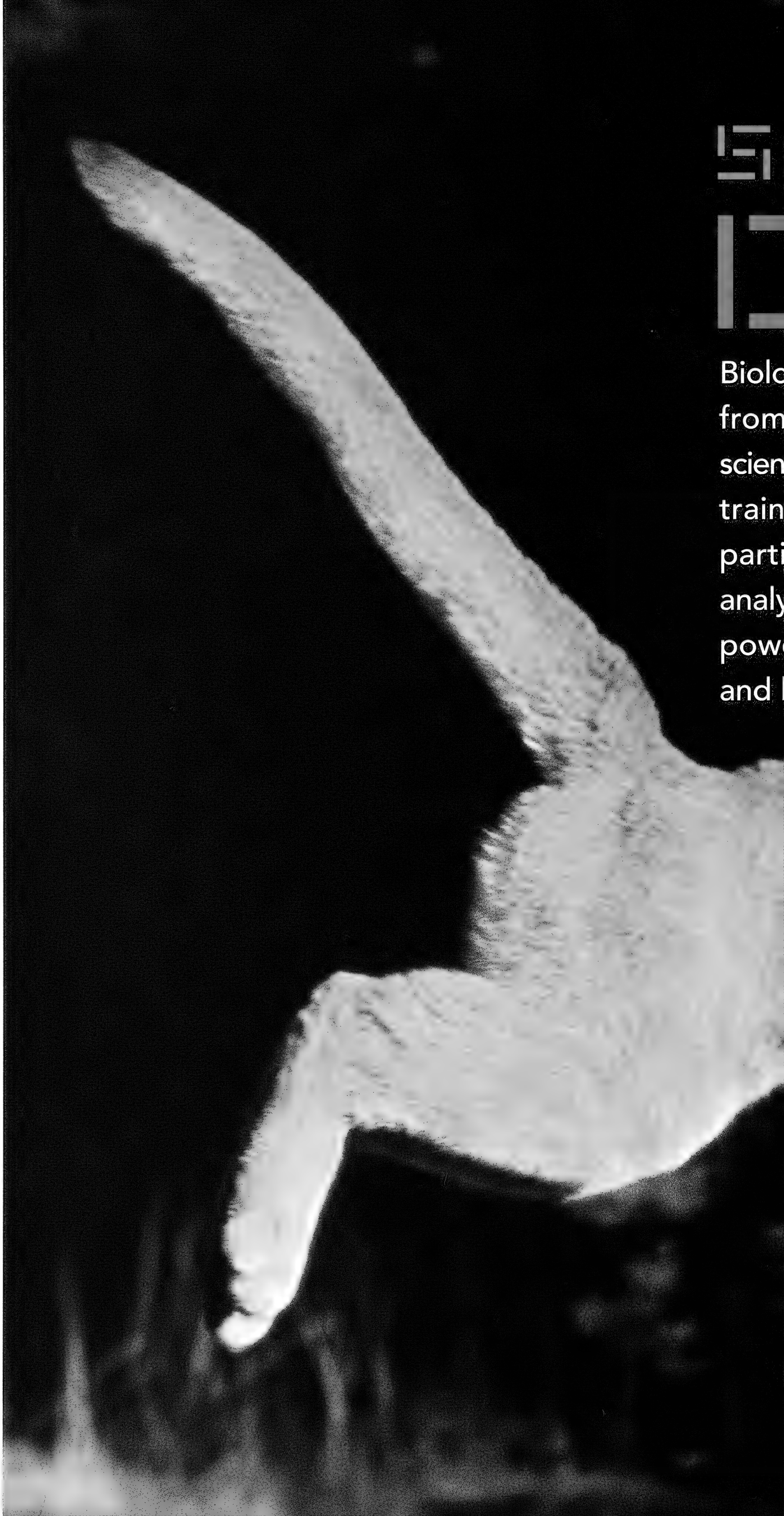
CONNECTIONS

In the course of talking about another article idea altogether, Robin Meadows mentioned work she'd heard about from Katherine Ralls on censusing kit foxes with the help of scat-sniffing dogs. This reminded me that Zoo Senior Curator John Seidensticker had once described an effort to use scat-sniffing dogs to identify individual tigers in the Russian Far East. This was starting to sound like a story.

John gave Robin the contact information for tiger biologist Linda Kerley, and Robin, while talking to Kathy Ralls and her student Deborah Smith, shared what she knew about Kerley's work. Kathy then called John to ask whether the Save the Tiger Fund, whose council he chairs, might be interested in funding a workshop to get Kerley, Smith, and others together to share experiences.

John was enthusiastic about the idea, noting that the National Fish and Wildlife Foundation, which manages the Save the Tiger Fund, had pioneered the use of dogs for conservation. Now, Kerley and Smith are working on a proposal to fund an informal seminar in Russia on training methods, research, and related concerns. They are planning to hold the seminar in the spring of 2003. Smith, in an email to Robin, wrote, "It should be a great experience and we are really excited you put us in touch with her!!"

—*Susan Lumpkin*



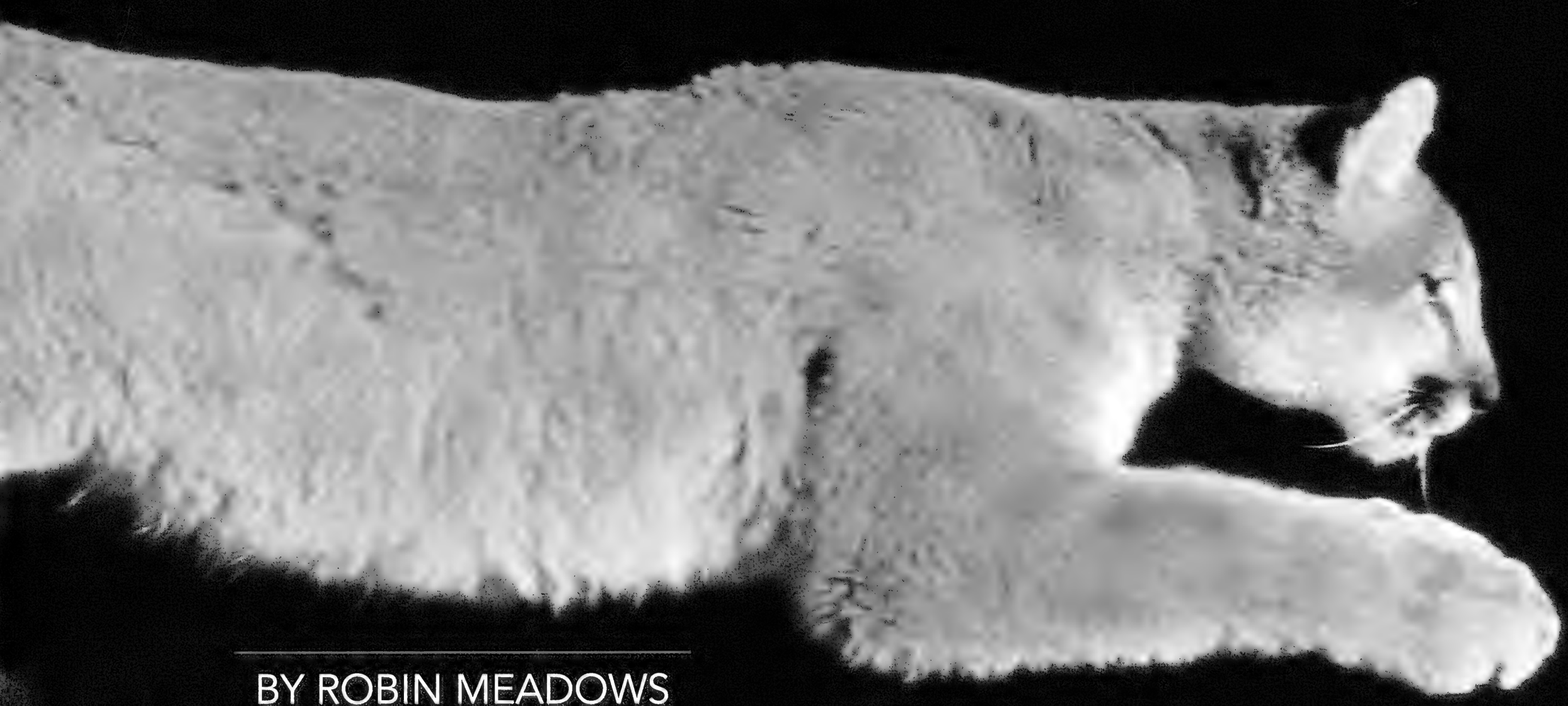
A NIGHT-PROWLING PUMA (*PUMA CONCOLOR*).

CAT-SNIFFING

DO

IT

ogists can learn amazing things poop—or scat (to be more tific). The first step is using dogs ed to sniff out scat from a cular species, the second is yzing the DNA in the scat. This erful combination of low-tech high-tech can give biologists a more accurate picture of wildlife populations than ever before, from how many animals there are to where they go. The technique can even identify individuals in a population. Scat sniffing is ideal for studying species like bears and tigers, which are hard to find and cover a lot of ground.



BY ROBIN MEADOWS

STEVE WEIGLEY/PACK LEADER DOG TRAINING

DAVENPORT'S TOP DOG.

"You can get a lot of information on species without ever seeing a single animal," says biologist Sam Wasser, who conceived the idea. Wasser worked at the National Zoo from 1989 to 1993, and was the first recipient of the NZP Research Scientist Development Award. He now directs the University of Washington's Center for Conservation Biology in Seattle.

Another benefit of scat sniffing is that it's non-invasive. The traditional method of studying carnivore populations is radiotracking, which involves trapping or tranquilizing the animals and then fitting them with radio collars. In addition to being stressful, this can sometimes cause injury or death.

Scat sniffing is catching on. Wasser is using it to study black and grizzly bears in the Pacific Northwest, and scat-sniffing dogs are also used to study tigers, cougars, lynx, wolves, foxes, and ferrets. The technique is not limited to carnivores or even to land animals; Wasser envisions that the dogs could also be used to study owls and right whales.

AH-HA!

Wasser was primed to make the connection between scat and DNA for two reasons. First, he had already been analyzing hormones in scat. His laboratory pioneered the technique for measuring reproductive and stress hormones in scat, which can show whether animals are pregnant, what their stress levels are, and whether stress levels increase when their habitat is disturbed. Wasser brought this method to the NZP's reproductive physiology program and, working with Steve Monfort and Janine Brown, used it on a wide variety of species, including owls, tree kangaroos, Alaskan moose, numerous cat species, wild dogs, maned wolves, and baboons.

The second reason that Wasser was primed to connect scat and DNA is that he had already been using a non-invasive method to collect bear samples for DNA analysis. This work, which was with the Washington Department of Fish and Wildlife, involved collecting samples of fur and analyzing the DNA in its follicles. The researchers collected the samples by putting a lure such as aged cow blood under barbed wire, which snagged the bears' fur on their way to the bait. However, this method has a potential problem: it could bias the results because some bears were far more likely to come to the bait than others. For instance, most of the fur samples were from males because females, especially those with cubs, avoid the lures.

Wasser got the idea of analyzing the DNA in scat while talking to a colon-cancer researcher who used human feces for genetic studies. During digestion, gut cells slough off and are excreted in feces—a gram of feces contains several million gut cells. The DNA in these gut cells is selectively multiplied using a molecular technique called PCR (Polymerase Chain Reaction), which can make millions of copies of specific DNA segments. These segments can then be analyzed to determine the species, sex, and identity of the animal.

THE BEST DOGS FOR SCAT SNIFFING ARE WORKING BREEDS THAT ARE BOTH LARGE AND AGILE ENOUGH TO SEARCH FOUR TO FIVE MILES OF DEMANDING TERRAIN PER DAY.

SCENT CONNECTION

The next challenge was figuring out the best way to collect the scat. Wasser thought that having people look for it could be biased because scats from some animals are hard to find. For instance, many animals avoid trails and females with cubs may try to hide their scat. Inspiration struck at a 1997 bear meeting in Ocean Shore, Washington, where people were talking about the recent ban on hunting bears with hounds. "They were wondering what to do with the hunting dogs. I thought they could train them to scent scat but they said narcotics dogs would be better," says Wasser.

It turned out that they were right. After a three-month search, Wasser ended up working with narcotics dog trainer Barbara Davenport, who manages the Washington Department of Corrections' Canine Program. "Sam came up with the idea, and he and one of his researchers started calling police agencies. They all laughed and said 'call Barbara Davenport,'" she recalls.

Davenport was perfect because she has been a dog person since she was ten, when she began working for a professional handler on the dog-show circuit. She had also trained and showed dogs through 4-H, and trained and groomed dogs at a kennel. Then her love of dogs led her to join the Army military police, where she learned how to train the dogs for patrol and narcotics detection.

At first, Davenport and Wasser trained scat-sniffing dogs under a cooperative agreement between the state Department of Corrections and the University of Washington. Now she collaborates with Wasser on her own time as part of her business, Pack Leader Dog Training, which trains stock dogs for competition. Davenport handles stock dogs herself and her Rottweiler has won a triple herding championship in cattle, sheep, and duck competitions.

Davenport based the scat-dog training on methods for training dogs to find illegal drugs. Dogs have such a keen sense of smell that they can even detect residue on drug paraphernalia. Narcotics training is rigorous; to be accredited, a dog and handler have to find 90 percent of the known samples hidden in a defined area.

The best dogs for scat sniffing are working breeds that are both large and agile enough to

CANADA LYNX (*LYNX CANADENSIS*).

search four to five miles of demanding terrain per day. Scat dogs also must have the right personality. They have to be hard-working and, since handlers reward them with a tennis ball, they have to be driven to retrieve. "They're unbelievably object-oriented, the only thing they want is their tennis ball all day long," says Wasser. This characteristic makes them unsuitable for pets. "Most of our dogs are rescued from the pound. They're unadoptable by the general public because they're high-energy and destructive," says Davenport.

associate the ball reward with the scat from a particular species. This entails putting the scat in one of five compartments in a scent box. Each compartment has a 2-inch hole in the top so the dog can smell what's inside. Then Davenport leads the dog down the scent box, tapping each hole so the dog will smell it. When the dog reaches the compartment that contains the scat, she immediately rewards the dog with the ball. Then she trains the dog to sit by the compartment that contains the scat.

GRIZZLY BEAR (*URSUS ARCTOS*).

Many of the 12 scat dogs she's trained were also unsuitable for narcotics work, which means working on tight leash and following a comprehensive search pattern at the direction of the handler. "It's very detail oriented and some dogs don't want to do it," says Davenport. "Scat work is much freer, there's more odor and more running back and forth."

OLFACTION 101

Training a scat dog takes several weeks of intensive work. First, Davenport conditions the dog to "This way they won't touch, scatter, or add their own DNA to the scat," says Davenport.

The next step is drilling the dogs in the field. "A scat dog is a cross between a narcotics dog and a wilderness search-and-rescue dog," says Davenport. Working with Wasser's team, she optimized the dogs' field training on black-bear scat samples placed on McNeil Island, in Puget Sound. The island was ideal because it's mostly forest, which is where the dogs would ultimately be searching for bear scat, and there are no bears, which meant that all the bears' scat samples were known. The dogs did have to distinguish bear scat from other species, however, because McNeil Island has many coyotes and deer.

The dogs also have to recognize a variety of black bear scats, which can differ considerably depending on what the bears have been eating. "It's best to train on scats that reflect the diversity of diets—bears can eat salmon, berries, and tubers, and the dog has to recognize them all," says Davenport.

Training the handler is just as important as training the dog because the pair works as a team. The handler has to both trust the dog and help it search effectively. For instance, if the dog smells a scat but can't find it, the handler needs to know how to guide the dog. "If there's a huge patch of blackberry brambles and the wind blows around it in a circle, the dog may run around in a circle too. The handler needs to move the dog past the obstacle by helping it find where the wind comes from before it blows in a circle," says Wasser.

Dogs are quite adept at finding scat in the field. "They can pick up bear scat from a quarter of a mile away under optimum conditions," says Davenport. While a dog's sense of smell is more than 1,000 times keener than a person's, dogs won't smell and find everything. "If there's a strong air current, they can miss scat that is five meters upwind," she says. Even so, dogs find a lot more scat than people could find on their own. In field tests, trained dogs can find roughly seven out of ten scat samples, which is excellent considering that the wind can't be controlled, says Davenport.

THE NOSE KNOWS

Because scat dogs can get more samples with less bias, the technique could have a tremendous impact on protecting species. "We can gather data we never could before get so objectively," says

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GRAY WOLVES (*CANIS LUPUS*) AT PLAY IN MONTANA.

Wasser. "It's hard data about conservation," adds Wasser, who has been using scat dogs for two major research projects. The first compares black bears (*Ursus americanus*) and grizzly bears in Canada's Jasper National Park with those in an adjacent area where there is coal mining, logging, and natural gas and oil extraction. His goal is to see whether these disturbances affect the bears. DNA analysis is used to determine the species, sex, and identity of individual bears, and this information is used to determine the size and distribution of the population. While it's too soon to say for sure, so far the results suggest that disturbance does affect the bears' distribution and stress levels.

STEVE WEIGLEY/PACK LEADER DOG TRAINING

SCAT DOG DOING FIELD TRAINING ON MCNEIL ISLAND.

His second scat-dog project is searching for grizzly bears in Washington's 10,000-square-mile Northern Cascade Grizzly Bear Recovery Area, about the size of Vermont. Right now there is no proof that any grizzly bears live in this recovery area, which means people could argue that it doesn't need to be preserved for the species. Indeed, the Plum Creek Timber Company recently won a court case saying that it no longer has to include grizzly bears in the area's Habitat Conservation Plan.

Wasser has found grizzly bear scat in the northern part of the recovery area. However, this is ambiguous because the scat could be from grizzlies that were just visiting from nearby parts of Canada. "If we find grizzly bear scat in the center of the recovery area, it could totally change conservation in the state," says Wasser. "Among other things, it will call into question the rulings on the Plum Creek HCP."

Researchers studying the critically endangered Amur tiger (*Panther tigris altaica*) in Russian

THE SAN JOAQUIN FOX (*VULPES MACROTIS MUTICA*).

B. PETERSON/U.S. FISH AND WILDLIFE SERVICE

forests have a different twist on scat sniffing—they bring scat to the dogs for identification. The researchers can't take them into the forest to find scat because the tigers will eat them. "We've found that they will go out of their way to catch a dog," says biologist Linda Kerley, who coordinates the project to monitor Amur tigers, which were formerly called Siberian tigers.

Fortunately, finding tiger scat is relatively easy. The big cats often defecate on trails and other open places because they use scat to mark the boundaries of their territories. It's also easy to distinguish tiger scats from those of the other local carnivores. For instance, tiger scat is cylindrical and contains hair and bone fragments, while bear scat is usually loose and contains some plant material.

The dog's job is to identify particular tigers in the population by first smelling the scat sample and then matching it with a particular scat in a reference collection from known tigers. To confirm that the dogs are identifying the scat correctly, each sample is matched to the reference collection by more than one dog.

The researchers identified the tigers in the reference collection with a combination of tracking and scat sniffing. First, the researchers tracked tigers in the snow and both measured their track sizes—which indicate the tigers' sex because males have bigger paws—and collected scat along the tracks. Then the researchers used the dogs to determine if scats along tracks in one location matched any of those along tracks in other locations.

By mapping the places where scats from particular tigers were collected, Kerley can determine how many tigers are living in a given area, where they are going, and whether the population's size is changing. "Monitoring our tigers using dogs is cheaper, faster, and less intrusive than other methods," she says. "We need to know if our anti-poaching strategies are working. We need to know immediately if tiger numbers begin to decline."

NEW AREAS TO SNIFF

Wasser sees a variety of other ways to use scat dogs. The technique could be a less stressful way of collecting scat from spotted owls in the Pacific Northwest. These threatened birds defecate under their roosts, but their scat is so small that people can take a while finding it, which is stressful for the owls. If dogs could find it faster, it may be less stressful on the birds.

Scat sniffing could even be adapted to studying endangered right whales in the Bay of Fundy in Maine. Researchers go out in boats to collect the whales' feces, which are bright orange (due to the whales' krill diet) and float for a while. The problem is that the feces are hard to see when the water is choppy so people can't always spot them before they sink. Scat dogs could be a great solution to this problem because the whales' feces are also malodorous—Wasser plans to train dogs to sit in the bow of a boat and point their noses toward the scent. Currently, the researchers manage to retrieve about 40 samples of right whale feces per season and Wasser thinks using scat dogs could bump that number into the hundreds.

Solid information on threatened species can be hard to obtain, making it difficult to justify conservation actions. Scat sniffing—whether on its own or in combination with DNA and/or hormone analysis—could help change that by providing hard evidence about animal populations. "These combined techniques offer a suite of new opportunities to wildlife managers and conservation biologists," says Wasser.

— Robin Meadows is a contributing editor to ZooGoer.

SCAT SNIFFING

ROBIN MEADOWS

Smithsonian's National Zoo zoologist Katherine Ralls and University of Washington graduate student Deborah Smith are using scat dogs to study the endangered San Joaquin kit fox in California's Central Valley. Ralls has studied kit foxes there for several years and thought that scat sniffing might be a better way to collect data. "I always like to use new techniques because you often discover new things; that's generally true in science," she says.

The dogs must distinguish kit-fox scat from the coyote, skunk, and badger scats in the study area. Ralls and Smith have found that scat dogs are remarkably accurate—Smith's German shepherd correctly picked out more than 300 kit-fox scats. Jesus Maldonado, a former Zoo scientist now at the Smithsonian's National Museum of Natural History in Washington, D.C., identified individuals from scat using DNA analysis. Ralls and Smith also found that dogs find considerably more kit-fox scats than experienced people—three times more on roads and nine times more in the scrublands where the foxes live.

Now Ralls and Smith are comparing scat sniffing with radiotracking, which is part of a separate study by Brian Cypher of the California State University at Stanislaus' Endangered Species Recovery Program. "It's looking good," says Ralls. "We found 963 scats in about a month and have analyzed 62, and already the scat locations are matching up well with the radiotracking locations for the same individual."

Besides providing reliable information about the kit-fox population, using scat dogs is efficient. "Once trained, scat dogs take less time than trapping and radiotracking," says Smith. The downside is that the scat-dog study is more expensive due to the cost of analyzing the DNA, which runs about $100 per sample. However, Ralls expects the cost of their scat research to become competitive with radiotracking as DNA analysis gets cheaper. "It's such a competitive field and everybody's pushing to improve the technology—it's the trickle-down effect of the emphasis on human genome sequencing," she says.

Books, Naturally

Smithsonian's National Zoo staff and associates have been especially prolific in 2002, with six new titles on subjects from birds and lion tamarins to oak forests and conservation genetics.

***Birds of the Mid-Atlantic Region and Where to Find Them* (in press) John H. Rappole. Johns Hopkins University Press, Baltimore, Maryland. 288 pp. clothbound, $49.95; paperback, $21.95 (Available in November, 2002)**

With its dramatic range of habitats, from beaches to wetlands and alpine forests, the Mid-Atlantic region is home to 346 species of birds. This new book is the only comprehensive field guide to bird life in the area that also directs readers to public sites where each species can be found. It includes extensive information about every species: description, identification details, habitat preference, vocalization, and Mid-Atlantic seasonal occurrence, abundance, and distribution. Each entry is accompanied by a color photograph and range maps, making identification easy for bird watchers. This helpful guide lists the best places to spot specific birds, from common species to rarities, and how to reach the sites by car.

John H. Rappole is a research scientist at the Zoo's Conservation and Research Center.

***Great Apes and Humans: The Ethics of Coexistence.* 2001. Benjamin B. Beck, Tara S. Stoinski, Michael Hutchins, Terry L. Maple, Bryan Norton, Andrew Rowan, Elizabeth F. Stevens, and Arnold Arluke, Eds. Smithsonian Institution Press, Washington, D.C. 384 pp. clothbound, $34.95.**

The great apes—gorillas, chimpanzees, bonobos, and orang utans—are our closest living relatives. The close relation of apes to humans raises important ethical questions. *Great Apes and Humans* is the first book to present a spectrum of viewpoints on human responsibilities toward great apes. Although this provocative book contains many different opinions, the uniting concern of the contributors is the safety and well-being of great apes.

Benjamin Beck is the Zoo's Associate Director for Animal Programs.

***Introduction to Conservation Genetics.* 2002. Richard Frankham, Jonathan Ballou, and David Briscoe. Cambridge University Press, Cambridge, England. 640 pp. clothbound, $130; paperback; $50.**

The biological diversity of the planet is being rapidly depleted due to the direct and indirect consequences of human activity. As the size of animal and plant populations decreases, loss of genetic diversity reduces their ability to adapt to changes in the environment, with inbreeding and reduced fitness inevitable consequences for many species. This textbook for advanced undergraduates and graduate students provides a clear and comprehensive introduction to genetic principles and practices involved in conservation.

Jon Ballou is population manager and research scientist at the National Zoo.

***Komodo Dragon: Biology and Conservation* (in press) James B. Murphy, Claudio Ciofi, Colomba de La Panouse, and Trooper Walsh. Smithsonian Institution Press, Washington, D.C. 324 pp. clothbound, $45. (Available in October, 2002)**

In the last 20 years, the populations of Komodo dragons—native only to a handful of islands in southeast Indonesia—have dwindled, sparking intensive conservation efforts. Over the same time, new information about these formidable predators has emerged. The most important findings are clearly presented here, with the latest information on Komodo dragon biology, ecology, population distribution, and behavior. The second part of the book is dedicated to step-by-step management and conservation techniques, both for wild and zoo dragons.

James B. Murphy is a research associate at the National Zoo. Trooper Walsh recently retired from the Zoo's Department of Herpetology.

***Lion Tamarins: Biology and Conservation* (in press) Devra G. Kleiman and Anthony B. Rylands, Eds. Smithsonian Institution Press, Washington, D.C. 384 pp. clothbound, $45. (Available in October, 2002)**

Without the extraordinary efforts of the editors and authors of this book, three of the four lion tamarin species—golden, golden-headed, black-faced, and black—would most likely be extinct. The Zoo's golden lion tamarin program, for example, set international standards and became the model for the conservation of other endangered species. Much remains to be done, and this comprehensive assessment of research findings and conservation efforts leads the way. The book covers the history of research and conservation for the four species, the principal research that has contributed to the management of the species in zoos and the wild, and the direct interventions necessary to conserve wild populations and their habitats.

Devra G. Kleiman is a research associate at the National Zoo.

***Oak Forest Ecosystems: Ecology and Management for Wildlife.* 2002. William J. McShea and William M. Healy, Eds. Johns Hopkins University Press, Baltimore, Maryland. 400 pp. clothbound, $60.**

Oaks are vital in the delicate web of relationships that sustains North American wildlife and form the foundation of many North American ecosystems. Acorns are an important part of the diets of more than 100 species of birds and mammals. This volume focuses on the relationship between an oak forest's acorn yield and the wildlife that depend on it.

William McShea is a research biologist based at the Zoo's Conservation and Research Center.

***Smithsonian Book of Giant Pandas.* 2002. Susan Lumpkin and John Seidensticker. Smithsonian Institution Press, Washington, D.C. 224 pp. clothbound, $39.95; paperback, $19.95 (Paperbacks are available only through the National Zoo Store at the Zoo or online at www.fonz.org)**

The recent arrival of the Zoo's giant pandas—Tian Tian and Mei Xiang—created an enormous outpouring of public support for the conservation of this endangered species. The first step toward ensuring a future for giant pandas is understanding both their history and their current relationship with people. This book explores these subjects and presents a resonant natural

history. Many of the stunning photographs are by Zoo photographer Jessie Cohen, and the foreword is by Zoo Director Lucy Spelman.

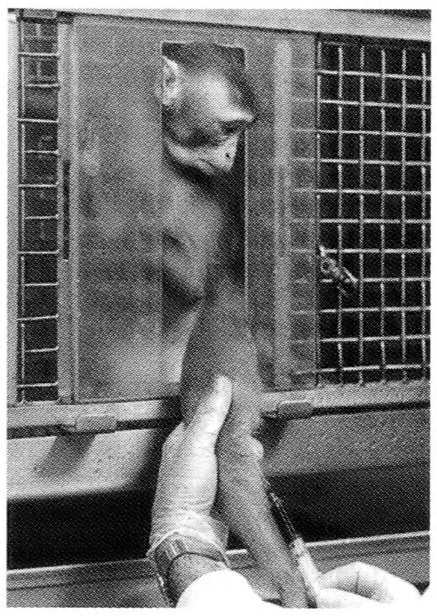
Susan Lumpkin is FONZ Director of Communications and editor of ZooGoer.
John Seidensticker is the Zoo's Senior Curator.

Correction: The price of A Road Through Mali-Kuli *was incorrect in the July/August "Books, Naturally." The correct price from www.1stbooks.com is $17.50.*

Bio Almanac

GOOD NEWS

Zoo biologists have long trained animals to cooperate with keepers and veterinarians. The Zoo's giant pandas, for example, were recently trained to voluntarily participate in blood draws. In a movement initiated largely by Viktor Reinhardt, a veterinarian and ethologist now with the Animal Welfare Institute, primate test subjects have been trained to cooperate during common medical research procedures, including voluntarily offering a leg for blood draws or injection and presenting a body part for topical drug application. Traditionally, such procedures require that the research subject be forcibly restrained, which increases the animal's stress level and, some researchers believe, ultimately distorts the results of the experiment. Unfortunately, no one has yet conducted the experiments necessary to prove that lowering stress levels yields more consistent data. Despite persistent resistance to the use of voluntary training in most biomedical labs, Reinhardt remains hopeful: "There is an increasing awareness among scientists that this is an issue that must be discussed and put into practice."



VIKTOR REINHARDT

BAD NEWS

Things heated up in Iceland in late July as the country's government inked a deal with industrial giant Alcoa that would eradicate the second largest unspoiled wilderness area left in Europe. The three-billion-dollar plan to construct an aluminum smelter in the middle of the Thjorsarver Nature Reserve exploits a loophole in the 1981 decree establishing Thjorsarver, one that allows the construction of a hydroelectric dam if approved by the appropriate government agency. The dam, a requirement for the massive energy needs of the smelter, will ultimately disturb, desertify, or drown up to 12,000 irreplaceable square miles of mixed wetlands, tundra, and permafrost—prime wildlife habitat from which drain Iceland's most breathtaking waterfalls.

Despite a chorus of opposition from the World Wildlife Fund, Birdlife International, private citizens, and Iceland's pop diva Bjork, the Icelandic government has given the go-ahead to its national power company to begin construction of the 623-foot-high dam. In answer to the international outcry, Iceland's prime minister has argued that the project will create 1,000 permanent jobs in an area Icelanders are deserting en masse. Ironically, the cause of this emigration is an unrelated environmental disaster: the collapse of fishing stocks.

RAX/ICELANDIC NATIONAL CONSERVATION ASSOCIATION

THORSAVER AFTER COMPLETION.

RECLAIMING WETLANDS

Along the southern shoreline of San Francisco Bay, there is a psychedelic, Martian wasteland familiar to anyone who has ever looked out the window of a plane on approach to San Francisco International Airport. This stretch of technicolor salt flats is about to become the second largest wetland restoration effort in the United States, after the Everglades.

The nearly 16,500 acres of shore frontage, currently owned by Cargill Industries, Inc., have been used for salt production for nearly a century (shallow sea water ponds are allowed to evaporate, leaving salt behind). This December, a coalition including the state of California, the federal government, and private philanthropic organizations will pony up $53 million for the land ($43 million more will be paid to Cargill once it completes an initial cleanup).

According to David Lewis, Executive Director of Save San Francisco Bay, years from now this 20-mile swath of shoreline will again be home to the nearly two dozen endangered species of marsh-dwelling fauna native to California, including pelicans, stilts, and curlews. The marsh will also, like all wetlands, increase local water quality by filtering the bay of pollutants and absorbing floodwaters during storms.

The only stumbling block remaining is the projected costs of restoration, which range from 150 million dollars to more than half a billion dollars. Luckily, Mother Nature appears capable of restoring some of the ponds.

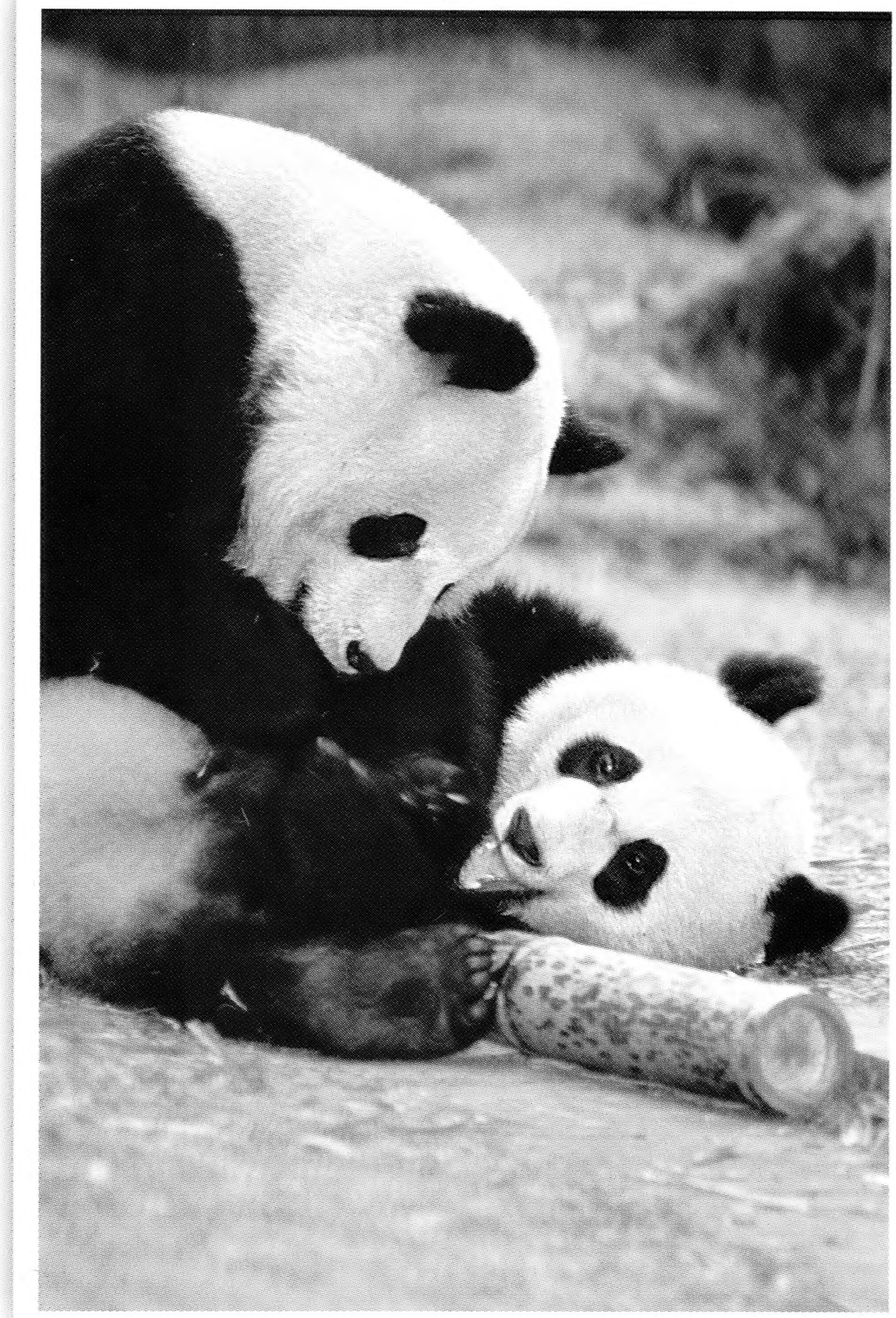
WHAT'S IN A NAME?

In 1842, in Old London Town, the Strickland Committee on taxonomy and nomenclature sealed the fate of a 200-million-years-dead dinosaur, an extant beetle, and an Australian entomologist. The committee ruled, according to Stephen Jay Gould in his essay *Bully for Brontosaurus*, that the first name given a species in print shall forever-after be its identity in the eyes of science.

One hundred and sixty years later (or sometime last spring), Adam Slipinski, of CSIRO Entomology, discovered that a beetle native to Madagascar, *Syntarsus*, bore the same moniker as a small bipedal dinosaur that last saw the light of day sometime in the Jurassic period. It's not uncommon for scientists to discover that one species has been named twice (or even, in the extreme case of the protozoa *Tetrahymena pyriforme*, 11 times), but to find two species with the same made-up Latin name is comparable to being struck twice by lightning in the span of a single game of golf.

It turns out that a French entomologist named the beetle in 1869, exactly 100 years before the discovery of its dino doppelganger. This left Slipinski, who has never dug up a bone in his life, in a peculiar position: he got to name the now-anonymous theropod. He called it *Megapnosaurus*. It means, in the language of Caesar: "Big dead lizard."

—*Christopher Mims*, ZooGoer *intern*



Some images preserve more than memories.

Partners in Conservation Education

In an effort to secure their future in China and North America, Fujifilm is proud to sponsor the future home of two giant pandas at the Smithsonian's National Zoo. Mei Xiang and Tian Tian will be housed in a state-of-the-art facility under the care of the National Zoo. Fujifilm recognizes that although photography is wonderful for preserving memories, it can never replace the real thing. www.fujifilm.com

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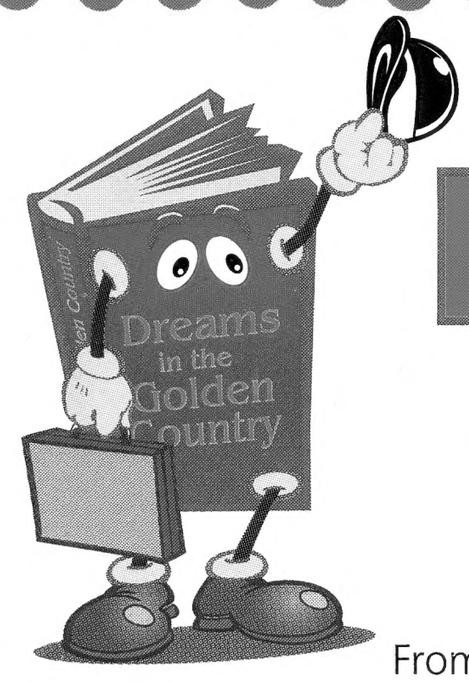

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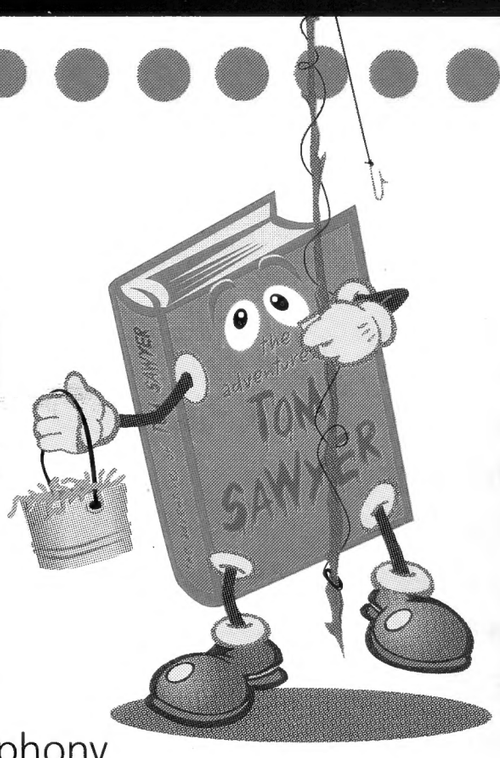

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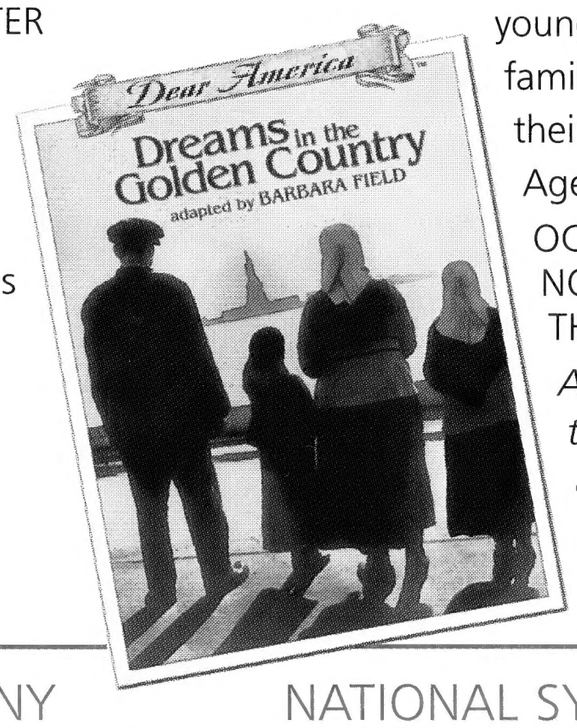
OCTOBER 18, 19, 25-27, NOVEMBER 1-3, THEATER LAB

A co-commission by the Kennedy Center and Scholastic Entertainment Inc.



Gayle Ross

The popular Native American storyteller returns to weave more trickster tales, creation myths, and folk legends. Ages 5 and up.

OCTOBER 18-20, AFI THEATER

Just Like a Puppet

Mock Turtle Marionette Theater presents an enchanting tale that shows how marionettes work, featuring all kinds of puppets, and marionettes from Africa and Japan. Ages 4 and up.

OCTOBER 25-27, AFI THEATER

NATIONAL SYMPHONY ORCHESTRA KINDERKONZERTS

Bravo Brass!

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OCTOBER 5, THEATER LAB

PHOTO BY SCOTT SUCHMAN

Strings Swing

NATIONAL SYMPHONY ORCHESTRA ENSEMBLES

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OCTOBER 6, THEATER LAB

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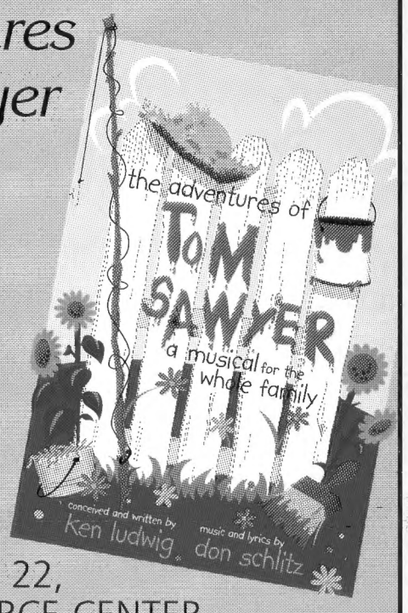

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